AMERICAN MACHINIST

December 25, 1940

For Spitfires—*Cartridges from a Canadian arsenal travel a long way before they leave the business end of a machine gun over the Channel*

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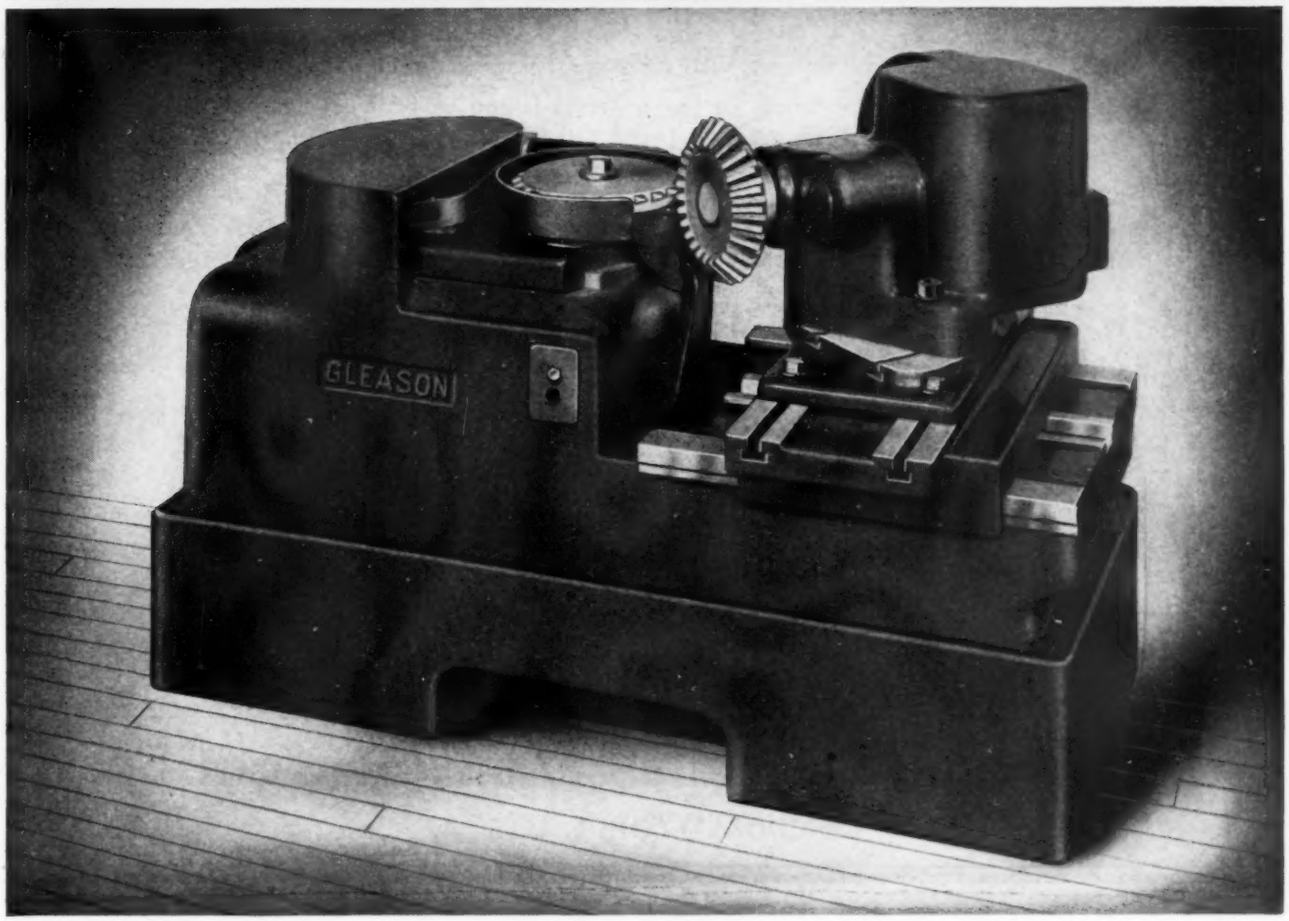
AMERICAN MACHINIST

GLEASON ANNOUNCES AN ENTIRELY NEW METHOD AND MACHINE FOR ROUGHING STRAIGHT BEVEL GEARS

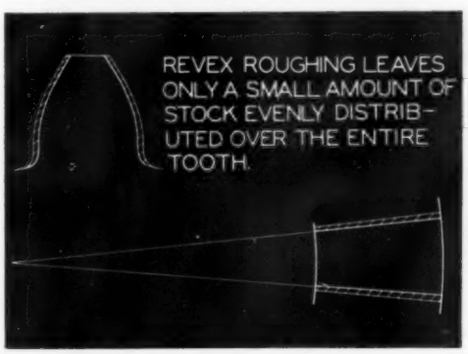


GLEASON No. 7 REVEX STRAIGHT BEVEL GEAR ROUGHER

On the new Revex Rougher, straight bevel gears are roughed closer to finish size than on any other roughing machine.

The Revex produces both the proper tooth taper and profile shape by the combined effect of the cutter motion and form of the cutter blades. Only a small amount of stock, evenly distributed over the entire tooth, is left for the finishing operation.

Revex Roughing is faster than other methods, and with the close roughing obtained, Gleason Generators finish-cut fully 30 to 40 per cent faster.



Send prints for complete information on how the Revex Rougher can increase your capacity and decrease your gear-cutting cost.

SPECIFICATIONS

Maximum Pitch Diameter (6 to 1 ratio)	14″
Coarsest Pitch	3 D. P.
Greatest Face Length	2″
Extreme Ratio (shafts at 90°)	6 to 1
Index Range	13 to 100 Teeth
Feed Rate	4 to 33 sec. per Tooth
Floor Space	40″ x 85″

GLEASON WORKS

Builders of Bevel Gear Machinery for Over Seventy-five Years

1000 UNIVERSITY AVENUE, ROCHESTER, N. Y., U. S. A.

DUAL PURPOSE LATHE INCREASES PRODUCTION

How to obtain increased production without increasing floor area, and the number of machines employed in the manufacturing process of the business is one of today's most perplexing problems. If you are confronted with such a situation and the problem has to do with lathe turning, we believe we have a solution. It's the Lodge & Shipley Manufacturing Lathe, a lathe with the adaptability of an engine lathe and the speed and semi-automatic features of an automatic lathe.

Multiple Length Stops provide automatic disengaging of the longitudinal feed at any of five desired positions; Multiple Diameter Stops enable the operator to quickly duplicate diameters, while the Four-way Tool Block with the Connected Rear Rest and additional Rear Tool Block offers innumerable tooling possibilities.

All of the manufacturing lathe attachments can be instantly disengaged and the lathe operated as a standard engine lathe.

Investigate the possibilities of this dual purpose lathe today by sending for your copy of "Examples of Turning".

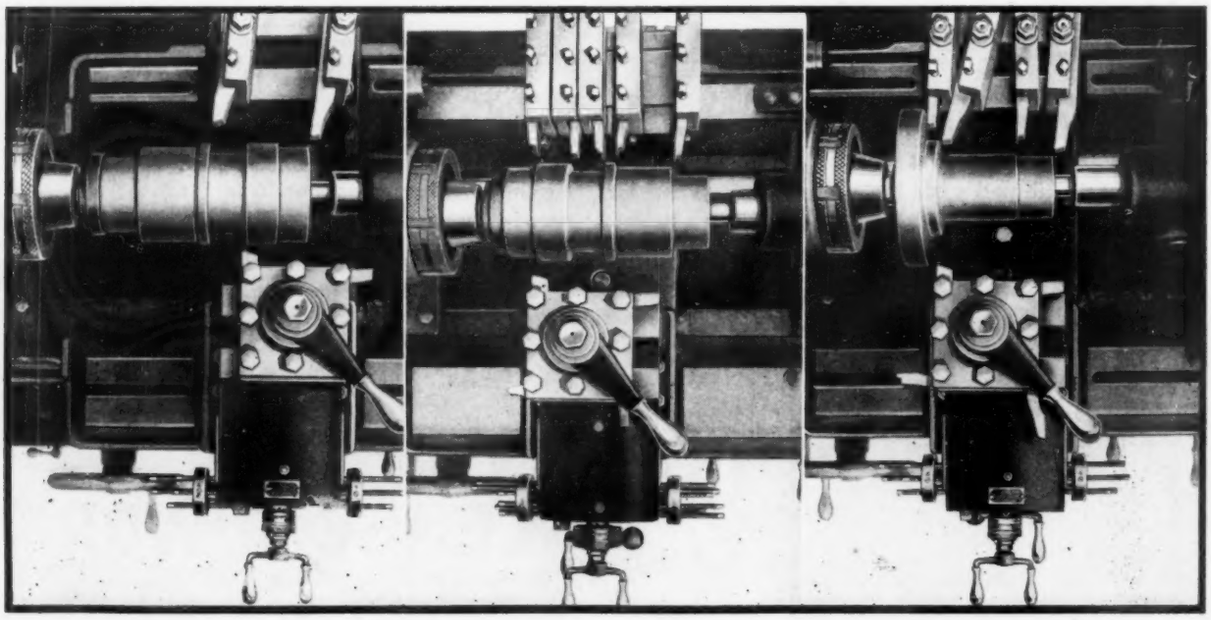
The Lodge & Shipley Machine Tool Co.

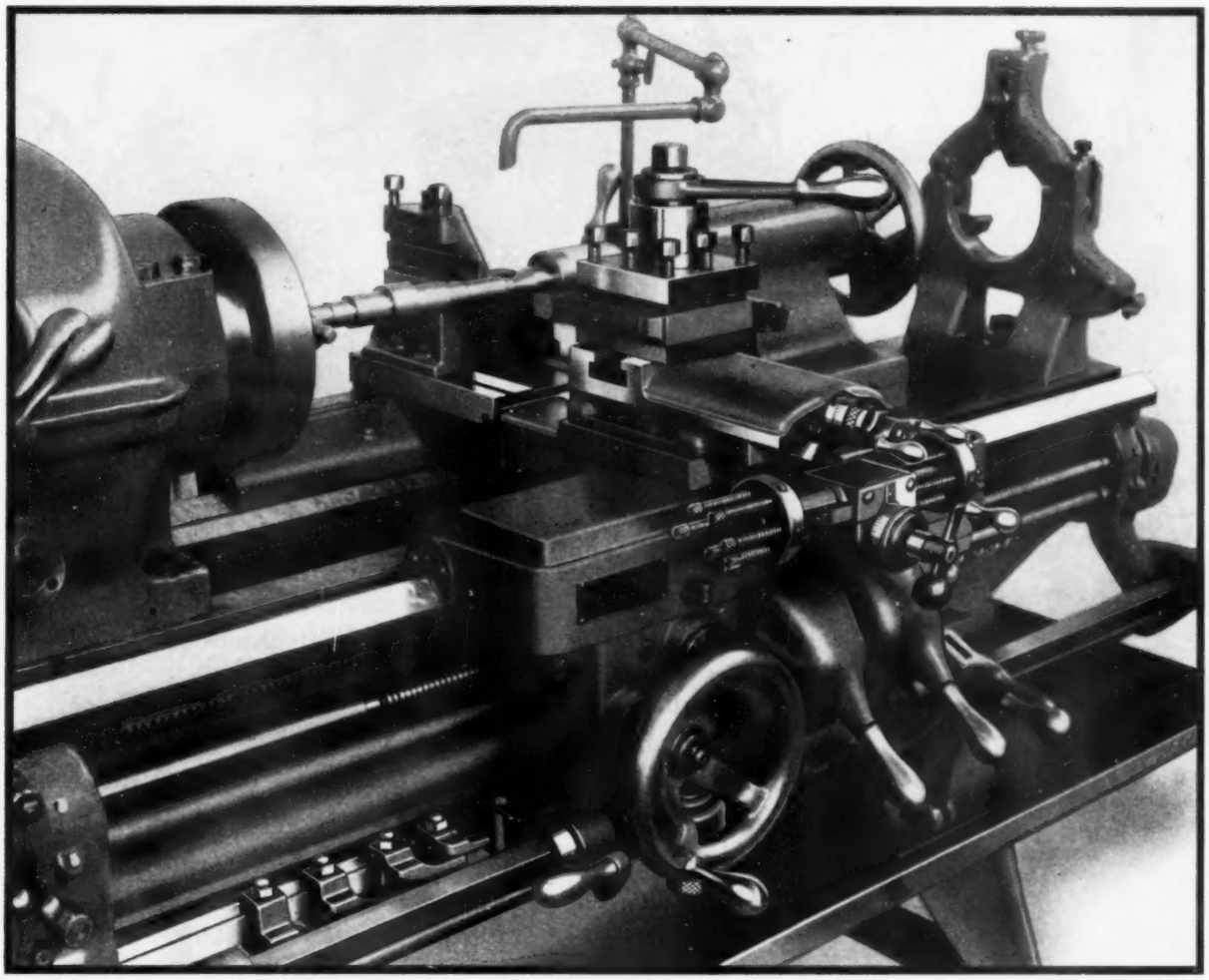
CINCINNATI, OHIO, U. S. A.

One end of sleeve is machined in the first operation using a combination of Swivel Tool Holders and Four-way Tool Block.

In the second operation, sleeve is turned end for end and the remaining operations performed using a Gang and Four-way Tool Block.

Facing and nicking operations on gear blank using four Swivel Tool Holders in the rear and a Four-way in the front.



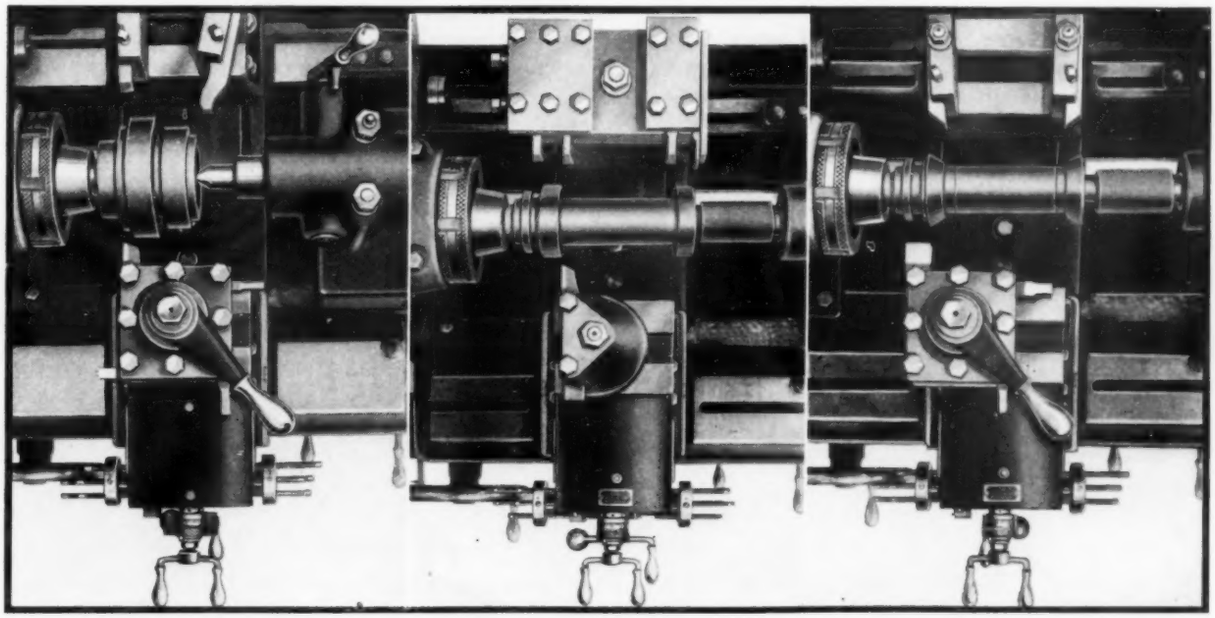


Lodge & Shipley 16" Selective Head Manufacturing Lathe.

Machining a cluster gear mounted on an arbor driven from the taper hole in spindle. Four-way Tool Block in front, two gang tool blocks in rear.

First operation on a double bevel gear using special tool blocks on the Connected Rear Rest in combination with the High Duty Tool Block on the Compound Rest.

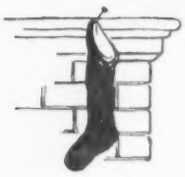
Second operation on double bevel gear, two bevels being formed in one operation using special forming tools in Swivel Tool Holders on the Connected Rear Rest.



'Twas the night before Christmas...

—when all through the house
Not a creature was stirring,—not even a mouse.
The stockings were hung by the chimney with care,
In hopes that Saint Nicholas soon would be there.

The children were nestled all snug in their beds,
While visions of sugarplums danced in their heads,
And Mamma in her 'kerchief and I in my cap,
Had just settled down for a long winter's nap.



When out on the lawn there arose such a clatter,
I sprang from my bed to see what was the matter.
Away to the window I flew like a flash,
Tore open the shutters and threw up the sash.

The moon on the breast of the new fallen snow,
Gave a lustre of mid-day to objects below,
When what to my wandering eyes should appear,
But a miniature sleigh and eight tiny reindeer;

With a little old driver, so lively and quick,
I knew in a moment it must be St. Nick.
More rapid than eagles his coursers they came,
And he whistled, and shouted, and called them by name:

"Now, Dasher ! now, Dancer ! now, Prancer ! and Vixen !
On Comet ! on Cupid ! on Donder and Blitzen !
To the top of the porch, to the top of the wall !
Now, dash away, dash away, dash away all !"

As dry leaves that before the wild hurricane fly,
When they meet with an obstacle, mount to the sky,
So up to the house-top the coursers they flew
With the sleigh full of toys, and St. Nicholas, too.

And then in a twinkle, I hear on the roof
The prancing and pawing of each little hoof.
As I drew in my head, and was turning around,
Down the chimney St. Nicholas came with a bound.

He was dressed all in fur, from his head to his foot,
And his clothes were all tarnished with ashes and soot;
A bundle of Toys he had flung on his back,
And he looked like a peddler just opening his pack.

His eyes how they twinkled ! his dimples how merry !
His cheeks were like roses, his nose like a cherry.
His droll little mouth was drawn up like a bow,
And the beard on his chin was as white as the snow.

The stump of a pipe he held tight in his teeth
And the smoke, it encircled his head like a wreath.
He had a broad face and a little round belly
That shook when he laughed like a bowl full of jelly !

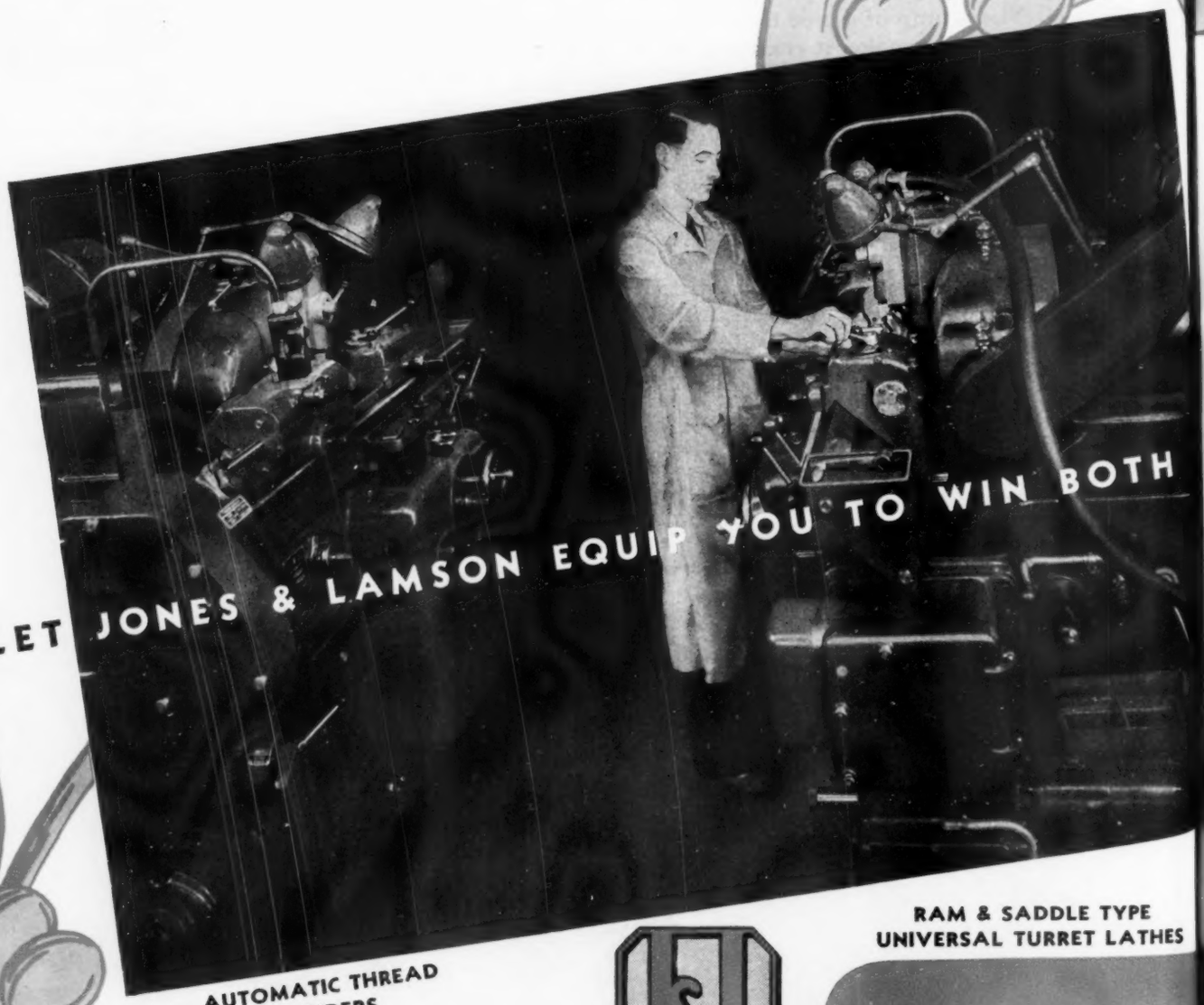
He was chubby and plump, a right jolly old elf,
And I laughed when I saw him, in spite of myself.
A wink of his eye, and a twist of his head,
Soon gave me to know I had nothing to dread.

He spoke not a word, but went straight to his work,
And filled all the stockings, then turned with a jerk,
And laying his finger aside of his nose,
And giving a nod, up the chimney he rose.

He sprang to his sleigh, to his team gave a whistle,
And away they all flew like the down on a thistle.
But I heard him exclaim ere he drove out of sight,
"Happy Christmas to all and to all A Good Night."

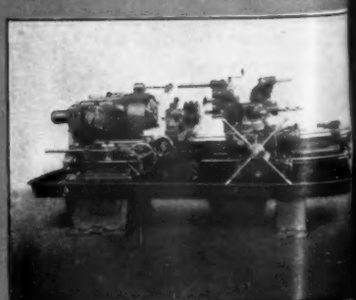
A Visit from
St. Nicholas
Clement Clarke Moore
1779 - 1863

"PEACE hath no



AUTOMATIC THREAD GRINDERS

RAM & SADDLE TYPE UNIVERSAL TURRET LATHES



J&L

PROFIT PRODUCING MACHINE TOOLS

her victories less renowned than war"

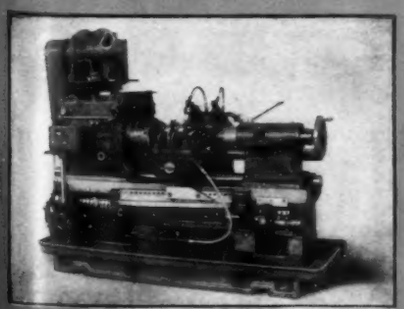
Special machinery built to manufacture defense orders can serve but one purpose. With the resumption of normal business it can only be scrapped or written off. On the other hand, Jones & Lamson standard equipment can handle a high proportion of your defense work to maximum advantage — and still be available to earn peace-time profits in the years ahead. That's why it pays to be familiar with all the possibilities of Jones & Lamson Fay Automatic Lathes, Universal Turret Lathes, Comparators, Automatic Thread Grinding Machines and Automatic Opening Die Heads. Before building or installing any machinery, put your production problems up to Jones & Lamson engineers.

JONES & LAMSON MACHINE COMPANY

Springfield, Vermont, U.S.A.

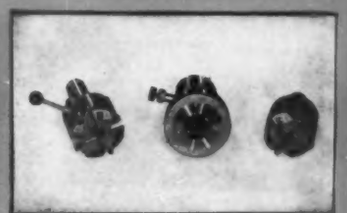
MANUFACTURERS OF SADDLE & RAM TYPE UNIVERSAL TURRET LATHES . . . FAY AUTOMATIC LATHES . . . AUTOMATIC DOUBLE-END MILLING & CENTERING MACHINES . . . AUTOMATIC THREAD GRINDING MACHINES . . . COMPARATORS . . . TANGENT AND RADIAL, STATIONARY AND REVOLVING DIES AND CHASERS

FAY AUTOMATIC LATHES



OPTICAL COMPARATORS

AUTOMATIC OPENING DIE HEADS



FELLOWS METHOD

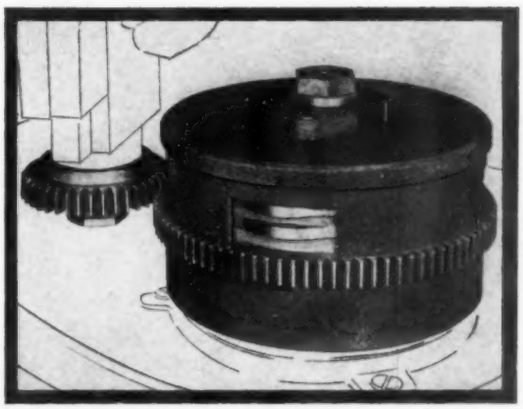
- CUTTING THE TEETH →
- FINISHING →
- INSPECTION →
- HARDENING →
- LAPPING OPERATION →
- INSPECTION AND OKAY →

FELLOWS

MACHINES AND TOOLS FOR GEAR PRODUCTION

Cost *per Gear OK'd!*

In the last analysis, the total cost is more important than the cost of any single operation. If, however, each operation is not conducted so that it reduces to the minimum the time required for the succeeding operations, then each succeeding operation will cost more than it should. The advantage of the Fellows Method is that production routine is so integrated that each operation is performed to the same high standard of accuracy, and overall costs are held to the minimum. Every gear man, if he has not already done so, should write for a copy of "The Fellows Method"—64 pages of illustrations and informative data in which he is directly interested. Write: The Fellows Gear Shaper Company, 78 River Street, Springfield, Vermont, U.S.A.



The Fellows Gear Shaper generates gear teeth to standards of accuracy which make succeeding operations less expensive. It will cut internal as well as external gears with spur or helical teeth. Special cutters adapt this process to the generating or forming of a great variety of shapes.

DETROIT OFFICE—616 FISHER BLDG. • CHICAGO—640 WEST TOWN OFFICE BLDG.

Method

. . . . . FROM BLANK TO FINISHED GEAR

SAVE WITH A *New* CINCINNATI

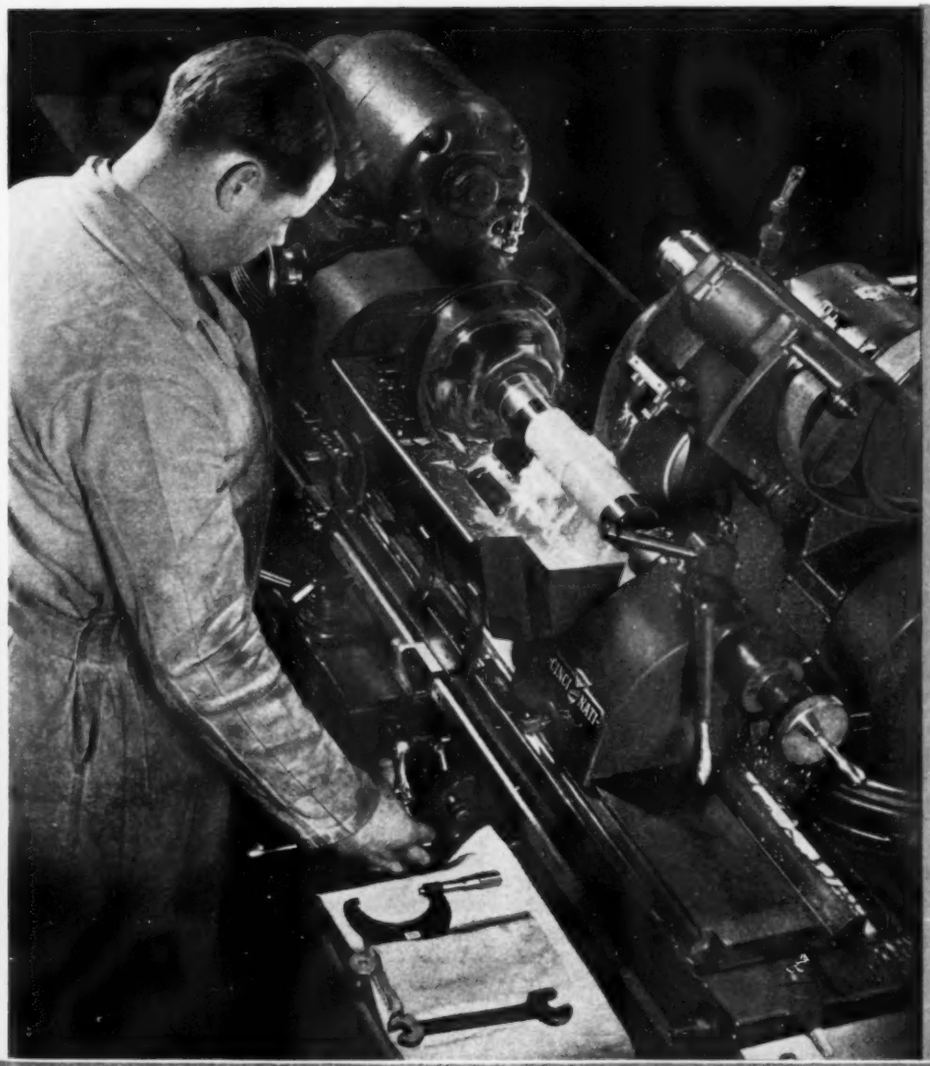
I GROW UP . . .

"Boy, Joe, ain't this a dandy train? Look at 'er shoot around the bend! Pop sure was a peach to give me this.

"Pop says that even little trains like this are better than they were five years ago. Pop says everything that's made of metal gets better each year.

"And, Joe, Pop works in a plant where they do the things that makes everything better. Ya oughta see the swell new grinding machine Pop runs now. Boy, oh boy is it fast! Pop says it's easier to use and does more different things than he's ever been able to do, and does 'em closer, he says. That means shinier, you know, and the right size.

"When I grow up I'm gonna work in a shop like Pop and make things like he does. I wanta run one of those machines, too."



Here's the CINCINNATI Hydraulic Universal Grinder that Bill's "Pop" is so excited about. And no wonder! The FILMATIC bearings give you a flutter-free spindle. A limit of .0001" is practical. "In and out" grinding from the same chucking is quickly handled with the hinged-type internal grinding attachment which is standard equipment and permanently mounted on the machine. Centralized controls for everything but swiveling the wheelhead makes for faster handling and setup. It's easy to grind accurately and rapidly on a machine you have perfect confidence in.

CINCINNATI GRINDERS INCORPORATED

CINCINNATI, OHIO

14", 16", 20", 24", 28" Plain Self-Contained Grinding Machines.

Nos. 2, 3, 4 Centerless Grinding Machines. Centerless Lapping Machines. 6" and 10" Plain Hydraulic Grinding Machines.

12", 14", 16" Universal Grinding Machines.

No. 26

Table: 50" x 12"

Range: 28" longitudinal, 12" cross, 18" vertical.

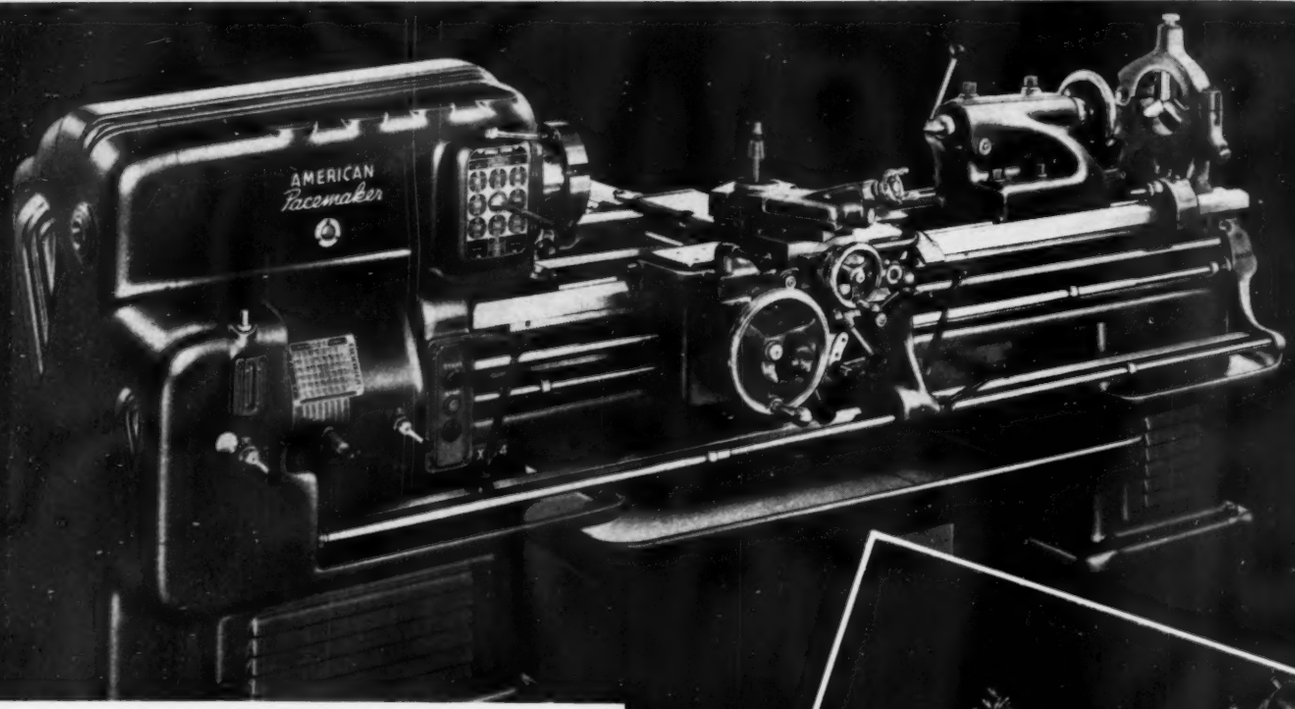
VAN NORMAN M

AN MILLING MACHINES...

VAN NORMAN Ram-Type Universal Millers are rigidly built for heavy cuts . . . sensitive and accurate . . . easy to operate and control . . . readily adaptable to a wide range of set-ups. On the new No. 26, shown, the massive table, knee and saddle are rapidly traversed in six directions, controlled at front and rear. Saddle and knee feeds are also front-and-rear controlled. Sliding ram and swiveling cutterhead are larger and heavier . . . combine their adjustments to permit successive horizontal, angular and vertical cuts with a minimum of resetting and with no attachments at all. Net result: Faster, easier, more accurate milling that cuts costs, builds output and profits. Write today for bulletins on Van Norman's complete line of Ram Type Universal Millers.

Van Norman Machine Tool Co., Springfield, Mass.

For Better Taper Turning



. . a better Taper Attachment by . . . "AMERICAN"

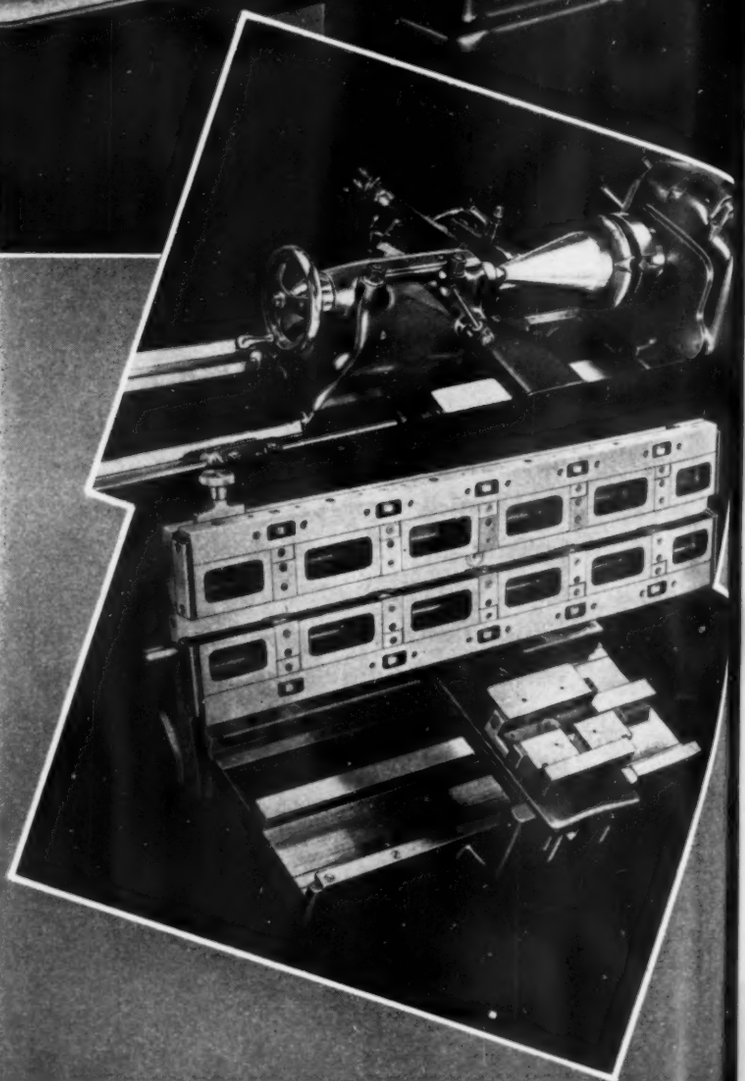
A brand new, greatly improved Ball Bearing Taper Attachment is now available for all sizes of "American" Pacemaker Lathes.

This new Attachment contains 24 permanently sealed ball bearings which reduce friction to an absolute minimum.

All ball bearings ride on hardened and ground steel "ways" thus insuring maintenance of accuracy and a minimum of wear.

All bearings are concealed so they are never exposed to chips and dirt, a design which eliminates the need for cumbersome dirt guards.

The new "American" Ball Bearing Taper Attachment is the very latest development in Taper Attachments and offers an anti-friction construction that is practical and effective, as well as one that will retain its original accuracy for a long period of time.

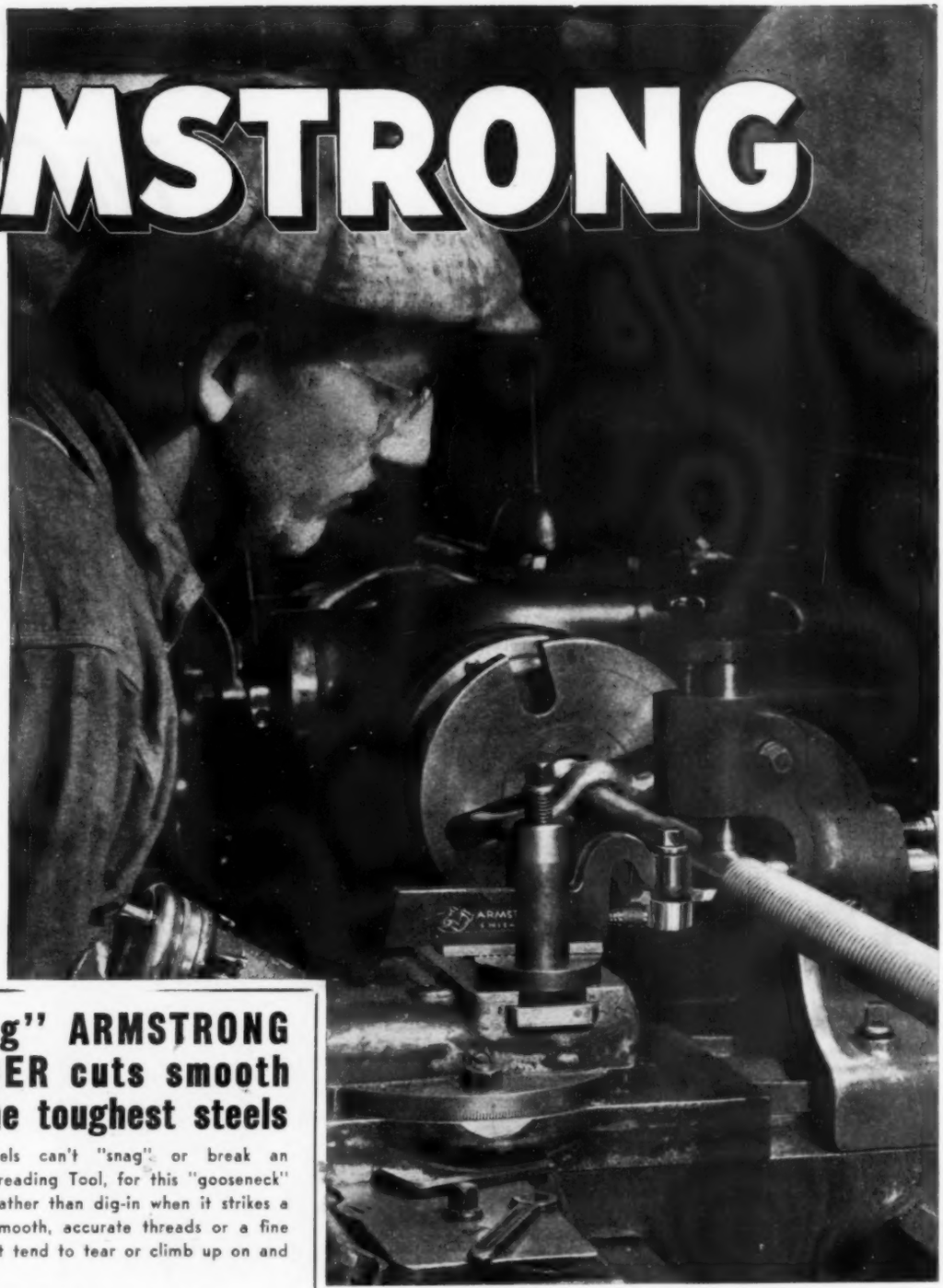


THE AMERICAN TOOL WORKS COMPANY

LATHES • RADIALS • SHAPERS

CINCINNATI • • OHIO • • U • S • A •

ARMSTRONG



This "Spring" ARMSTRONG TOOL HOLDER cuts smooth threads in the toughest steels

Even the toughest steels can't "snag" or break an ARMSTRONG Spring Threading Tool, for this "gooseneck" tool holder will "duck" rather than dig-in when it strikes a hard spot. It will cut smooth, accurate threads or a fine finishing cut in steels that tend to tear or climb up on and break a rigid tool.

It's a convenient tool too, for it takes cutters quickly ground from standard square shaped high speed steel, and holds them in any of 3 positions for "straight", "right hand offset" or "left hand offset" approach to the work. It is both a "spring" tool or a "rigid" tool—will take a roughing cut or do an ordinary turning job as a rigid tool, and with the turn of a plumb nut, it becomes a "spring" tool which many machinists consider helpful in obtaining a smooth finishing cut or thread in extremely tough alloy steels.

Wherever they are machining the new tougher steel, the ARMSTRONG Spring Threading Tool is one of the busiest tools in the shop. It answers a lot of machining problems.

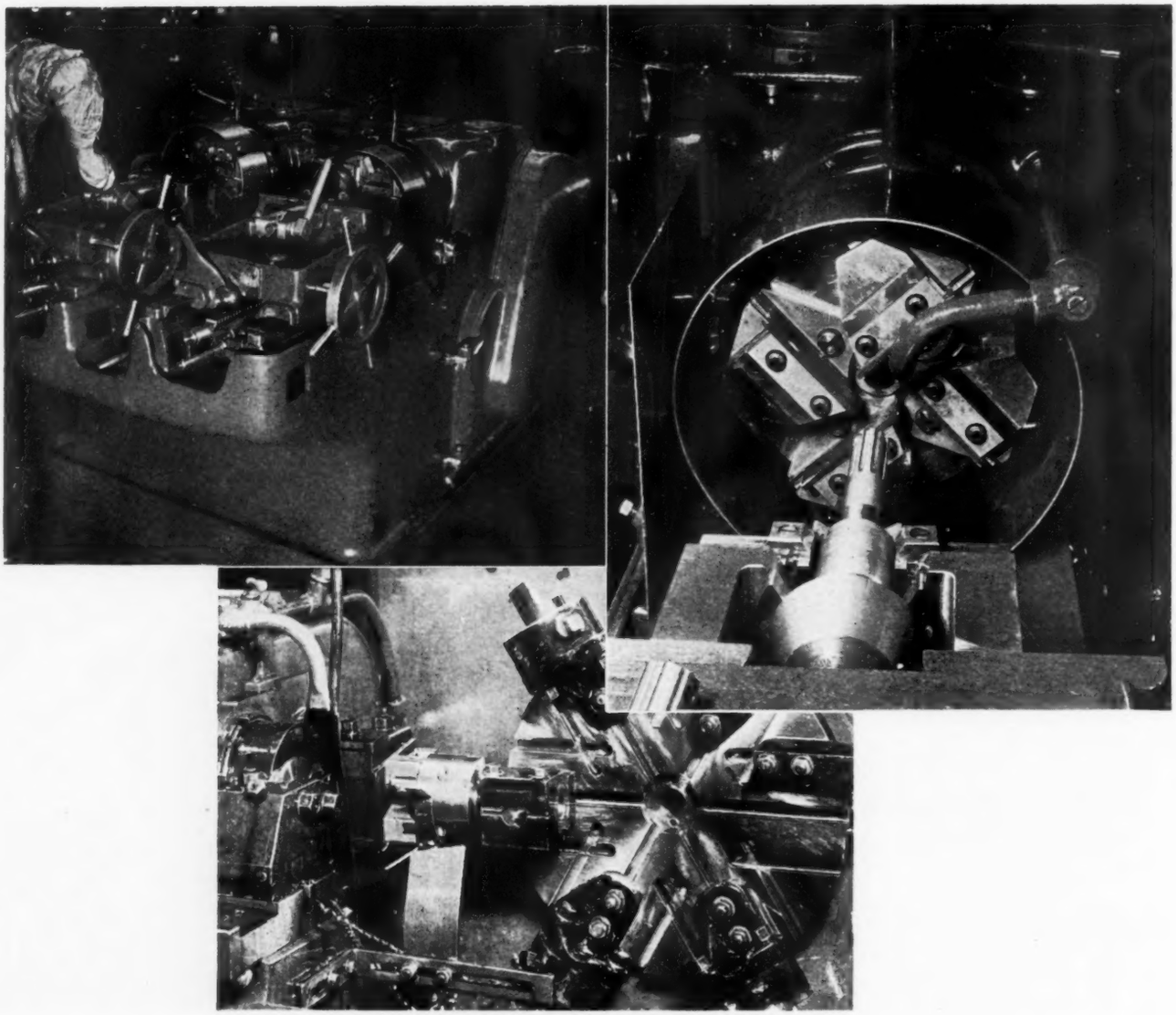
ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
305 N. FRANCISCO AVE. CHICAGO, U. S. A.

Eastern Warehouse and Sales:
199 Lafayette St., New York

Buy ARMSTRONG tools from your Supply House

ARMSTRONG TOOL HOLDERS Are Used in Over 96% of the Machine Shops and Tool Rooms

PERFORMANCE
MODERN



The **LANDIS** *Line*

STANDARD THREADING MACHINES
LANDMACO THREADING MACHINES
BOLT FACTORY THREADERS
AUTOMATIC FORMING AND THREADING MACHINES
SEMI-AUTOMATIC THREADING MACHINES
PIPE THREADING AND CUTTING MACHINES
PIPE AND NIPPLE THREADING MACHINES
ROLLER PIPE CUTTERS
CHASER GRINDERS
ROTARY BOLT THREADING DIE HEADS
STATIONARY PIPE DIE HEADS
LANDMATIC HEADS FOR TURRET LATHES
LANDEX HEADS FOR AUTOMATIC SCREW MACHINES
LANCO HEADS FOR HAND-OPERATED THREADING MACHINES
LANDIS COLLAPSIBLE AND ADJUSTABLE TAPS
LANHYDRO (Hydraulically Controlled) THREADING MACHINES

LANDIS MACHINE C
WAYNESBORO, P

E is the PROOF of NIZATION

The machine tools of 12 or 15 years ago were not designed and are not capable of producing the fine accuracy, at the high production, of present day requirements.

While Landis Die Heads and Threading Machines have long been recognized for their ability to produce threads of fine accuracy—the complete modernization of the entire LANDIS LINE now makes available for industry—Die Heads and Threading Machines which lead the way to new performance standards.

For Complete Modernization in Threading

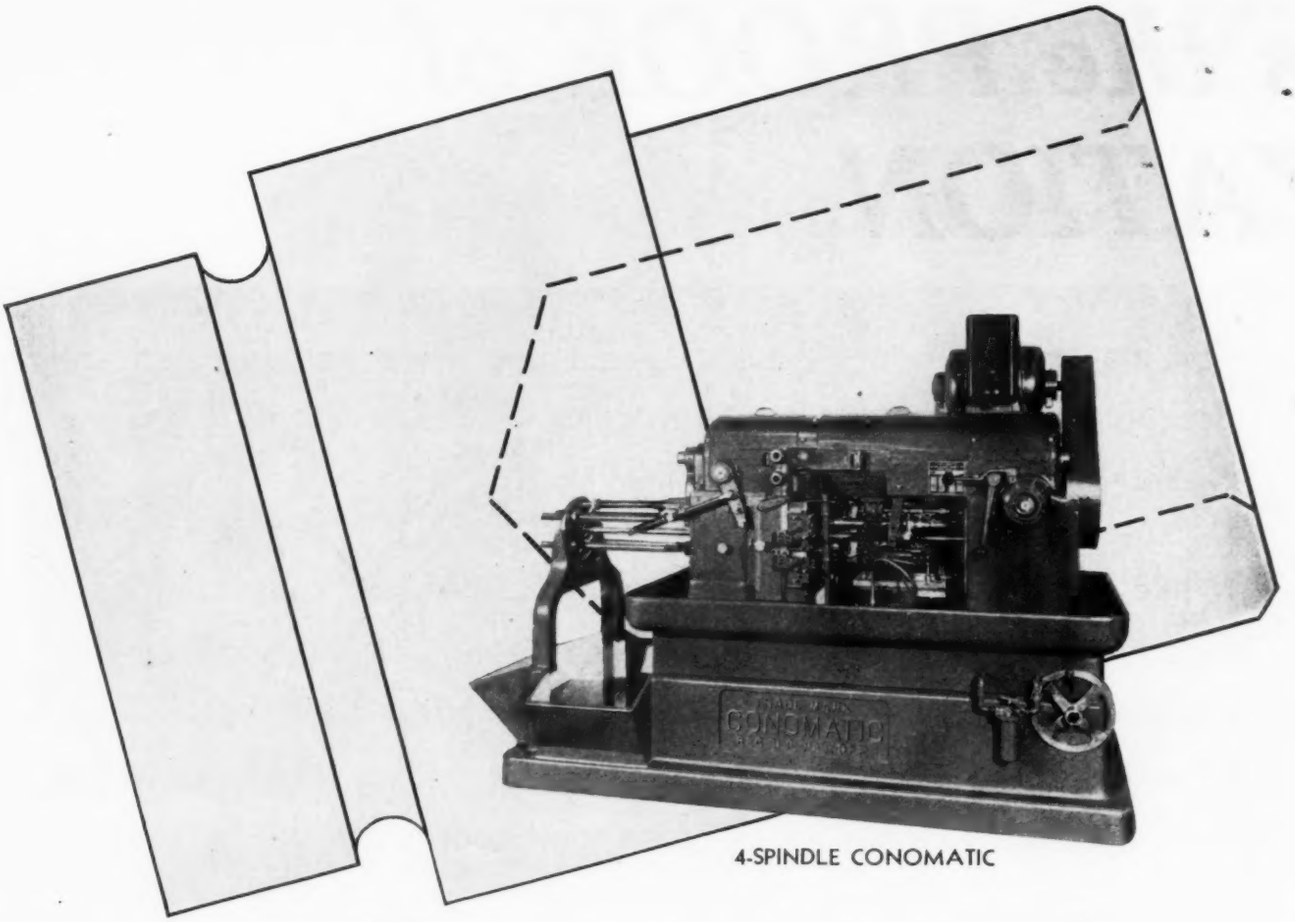
LANDISIZE

LANDISize—for Unexcelled Thread Accuracy—
for Greater Production — for Lower Threading Cost

LANDIS Die Heads and Threading Machines are employed extensively in almost every kind of industry. Investigate the advantages of using this modern Thread Cutting Equipment for your thread cutting operations.

Submit your threading problems to our Engineers today

E COMPANY, Incorporated
PENNA., U. S. A.



4-SPINDLE CONOMATIC

288 Pieces per hour

ON THE 4-SPINDLE CONOMATIC

THE 4-spindle Conomatic makes every second count on parts produced from bar stock. These seconds mean definite savings on every part, and present an opportunity for the progressive manufacturer to beat competition. Take the part shown here for example. It is produced in *ten seconds* — 288 per hour at 80% production!

Part produced in 10 seconds on the 7/8" 4-Spindle Conomatic (actual size).

The operations performed on this piece are as follows:

1st position — spot drill and form
2nd position — drill and form
3rd position — ream and form
4th position — cut off (a special pick-off attachment is used so that every part is finished clean on the end.)

Don't neglect the simple jobs, because they are the ones that can earn or lose money the easiest. Save the seconds and make the profits on Conomatics. Whether your next job is easy or difficult, let Cone estimate it for maximum profits — there is no obligation.

For complete details send for your copy of the 4-Spindle Conomatic Catalog.

CONE AUTOMATIC MACHINE COMPANY
WINDSOR, VERMONT, U. S. A.

Grind Knuckle Pin Holes on BRYANT Internal Grinders . . . in one set-up

THE Bryant No. 16–38" Hydraulic Hole Grinder, with special holding fixture, has proved the ideal machine for cutting the cost of grinding knuckle pin holes in aircraft engine, master connecting rods. Vital accuracy is obtained by means of an interesting indexing and holding fixture.

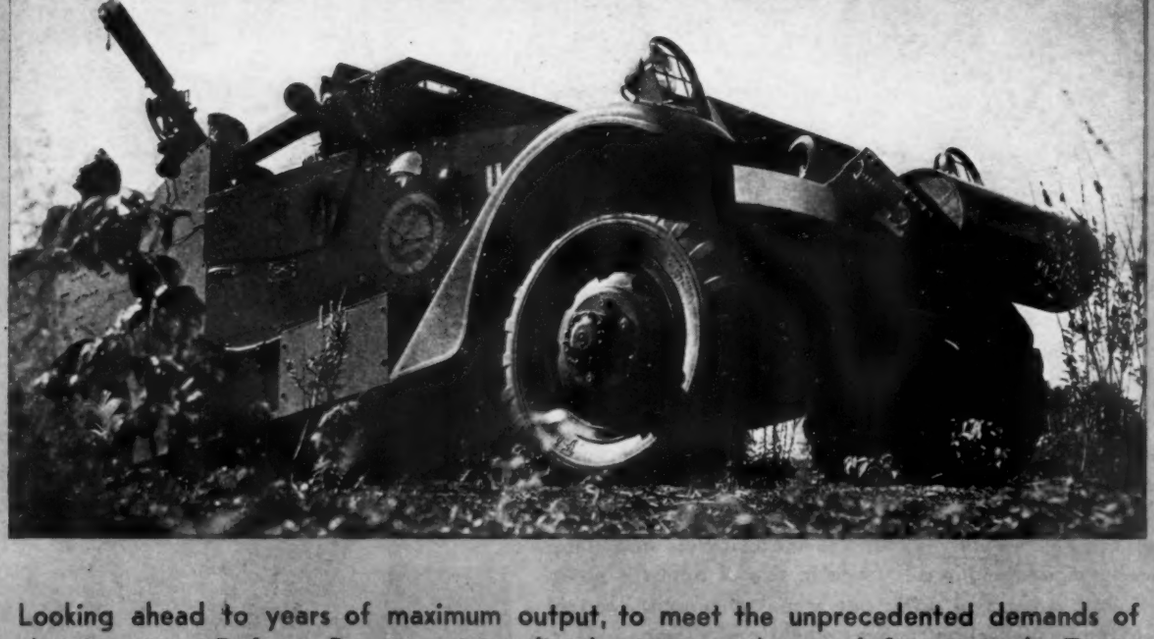
A centering plug in the work spindle accurately aligns the hole in the grinding position. The back knuckle pin holes in the connecting rod are .005" smaller than the front holes, yet the Bryant method of using a positive stepped guide for the wheel head completely eliminates inaccuracies, and automatically maintains the difference in size of both the holes. The Bryant method of using one wheel eliminates unequal wheel spindle deflection, uneven wheel and diamond wear, and sizing errors encountered by the two-wheel method. The sixteen holes in this rod are ground in approximately 40 minutes, floor to floor.

Bryant is prepared to help others prepare in the program of national defense. Increased plant facilities plus experience on thousands of internal grinding jobs are your assurance of prompt attention and complete satisfaction.

BRYANT
CHUCKING GRINDER COMPANY
SPRINGFIELD, VERMONT, U.S.A.

AMPLE POWER FOR HEAVIEST WORK

Precision for the Most Exacting Requirements



Looking ahead to years of maximum output, to meet the unprecedented demands of the American Defense Program, immediately suggests the need for a sturdy Turret Lathe applicable to general purpose work as well as to highly specialized production. Such a tool is the LIBBY — designed with ample power to stand up under continuous heavy-duty operation — built to handle work even beyond its rated capacity — sensitive enough to satisfy the most precise requirements — rugged enough to get the utmost out of the latest high speed cutting tools — versatile enough to prove profitable in any production assignment! Output facilities in the Libby Plant are such that early deliveries are assured. Write for complete details.

CMC CLEARING

Libby TURRET LATHES

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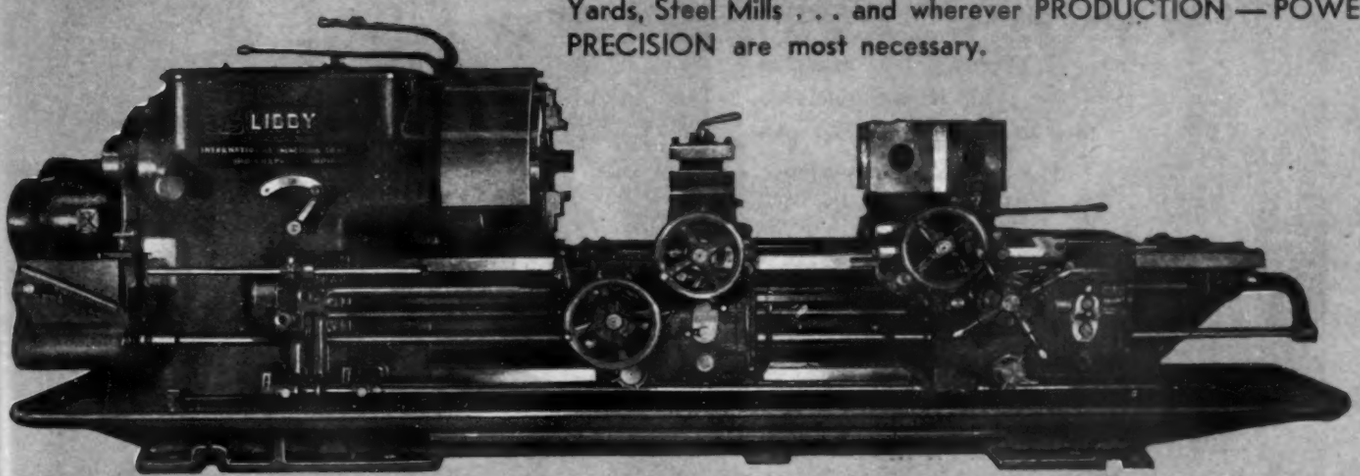
Libby

TURRET LATHES

ideally suited for National Defense Production . . . for speedily and accurately producing parts for Tanks, Heavy Ordnance, Rifles, Machine Guns, Anti-Aircraft Guns, Anti-tank Guns, Diesel Engines, Aircraft Engines, Airplane Landing Gears, Gas Engines, Turbines, Trucks, Tractors, Scout Cars, Gears, Valves, Bearings, etc . . . for Ammunition Production in Arsenals, Navy Yards, Production Plants, Maintenance Shops, Aircraft Factories, Ship Yards, Steel Mills . . . and wherever PRODUCTION — POWER — PRECISION are most necessary.



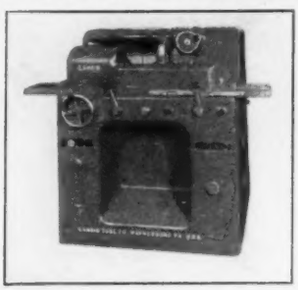
AL MACHINE TOOL COMPANY, INC

olis Indiana

RING MACHINE CORP., CHICAGO

4 GRINDING CYCLES

ONE SIMPLE MACHINE



Four distinct grinding cycles—all on one simple machine. That's a real money saving feature of the new Landis 4" Type H Plain Hydraulic and should be good news to all who grind small parts in quantity.

The following is a listing of these cycles:

A—Traverse grinding with automatic wheel feed.

B—Straight infeed grinding with hydraulic straight infeed.

C—Traverse grinding with hydraulic straight infeed.

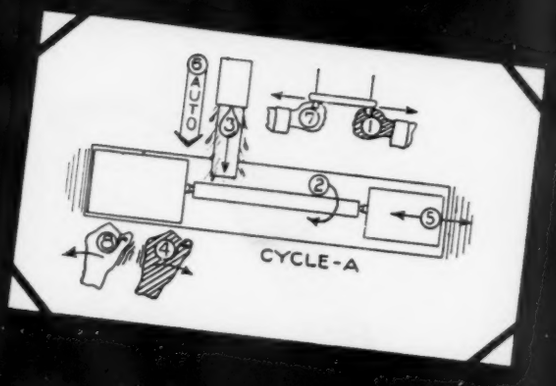
D—Straight infeed grinding with hydraulic straight infeed and hydraulic timer.

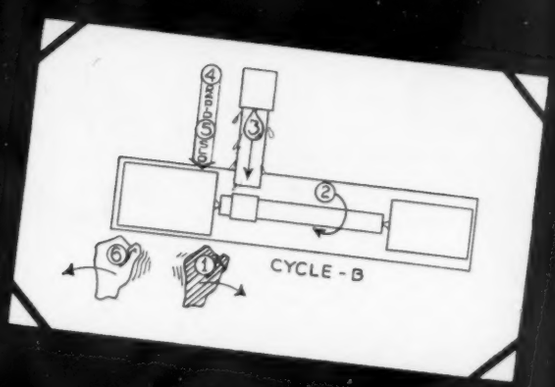
The amount of equipment required, other than standard, is not extensive. The way this equipment increases productiveness is a satisfying experience. And the uniformity of results has amazed every one of its users.

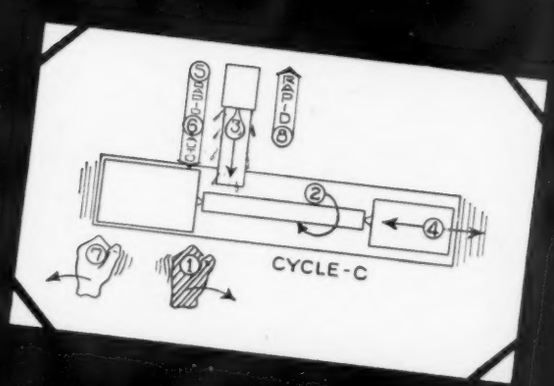
Request catalog No. A-140 so that you will have the entire story about this unusual Landis 4" Plain Grinder.

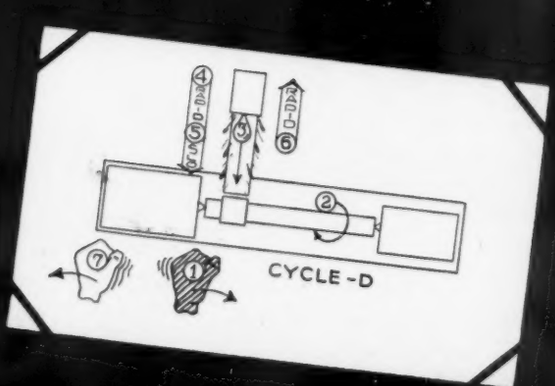
No. 353

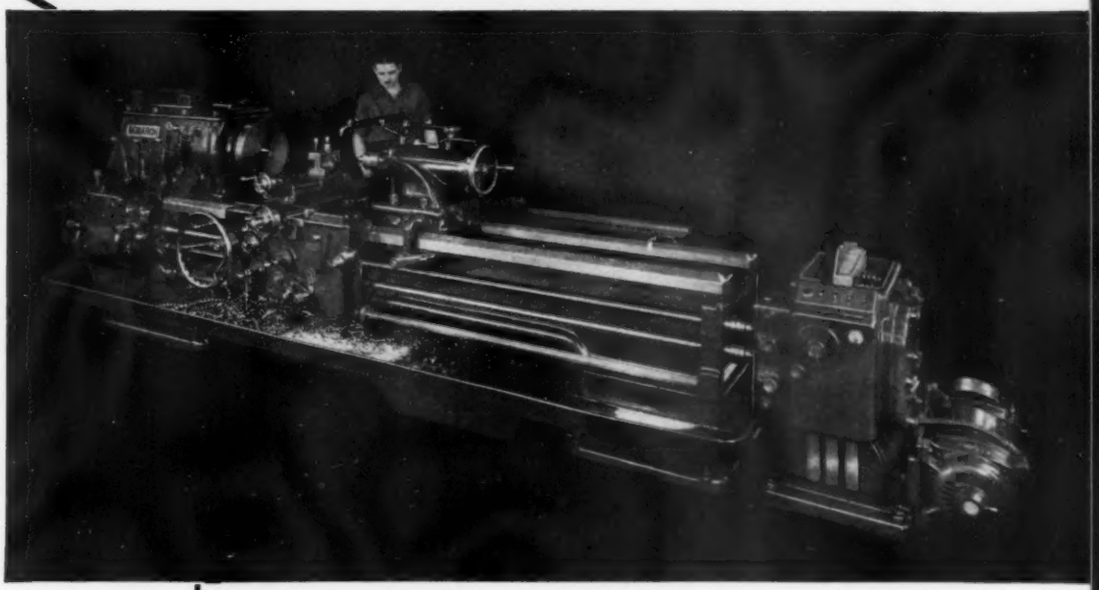
LANDIS TOOL COMPANY
WAYNESBORO, PENNSYLVANIA







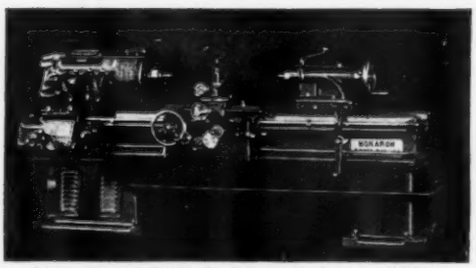




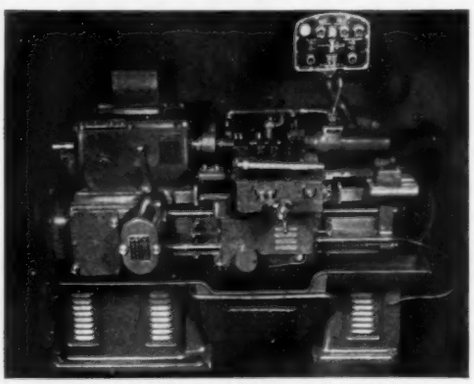
Monarch AUTOMATIC SIZING makes an automatic machine out of any size engine or tool room lathe.

MONARCH LATHES

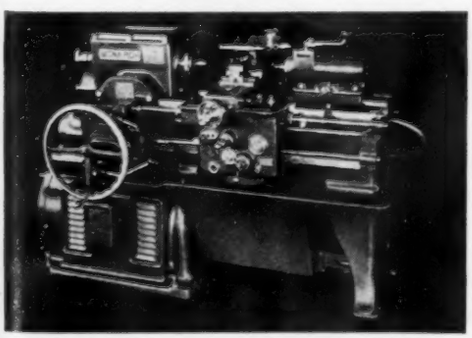
COVER THE TURNING FIELD



Monarch Model "C" Tool Room Lathes—available in 12", 14", 16", 18" and 20" sizes.



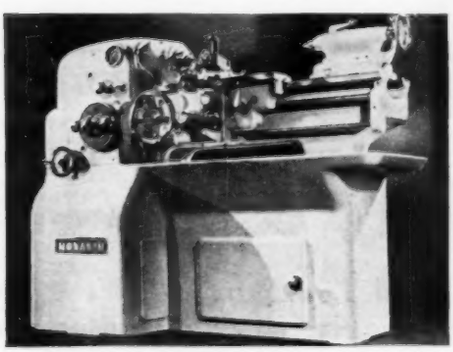
Monarch Magna-Matic Lathe — performs functions of many machines—is today's most universal automatic lathe.



Monarch 5-T Manufacturing Lathe—handles a variety of manufacturing jobs or a single quantity production job.

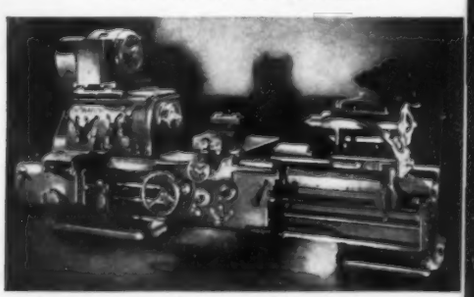
MORE and more, one name comes quickly to mind when you think of lathes—the last word in lathes—MONARCH. It is the symbol of progress, of technical advancement, of forward thinking. If a job is to be turned, it is likely that one of the many sizes and types of Monarch lathes will do the job better, faster, and at lower cost per piece. Monarch engineers can bring to your turning problems a wealth of experience gained during 31 years of broadening the scope of lathe production. The Monarch Machine Tool Company, Sidney, Ohio, U. S. A.

"Expansion Time" Lathes By Monarch Will Do Tomorrow's Competitive Job.



10" Sensitive Precision Lathe—this 2,000-pound, 3 H. P. lathe fills a long-felt want in the Tool Room.

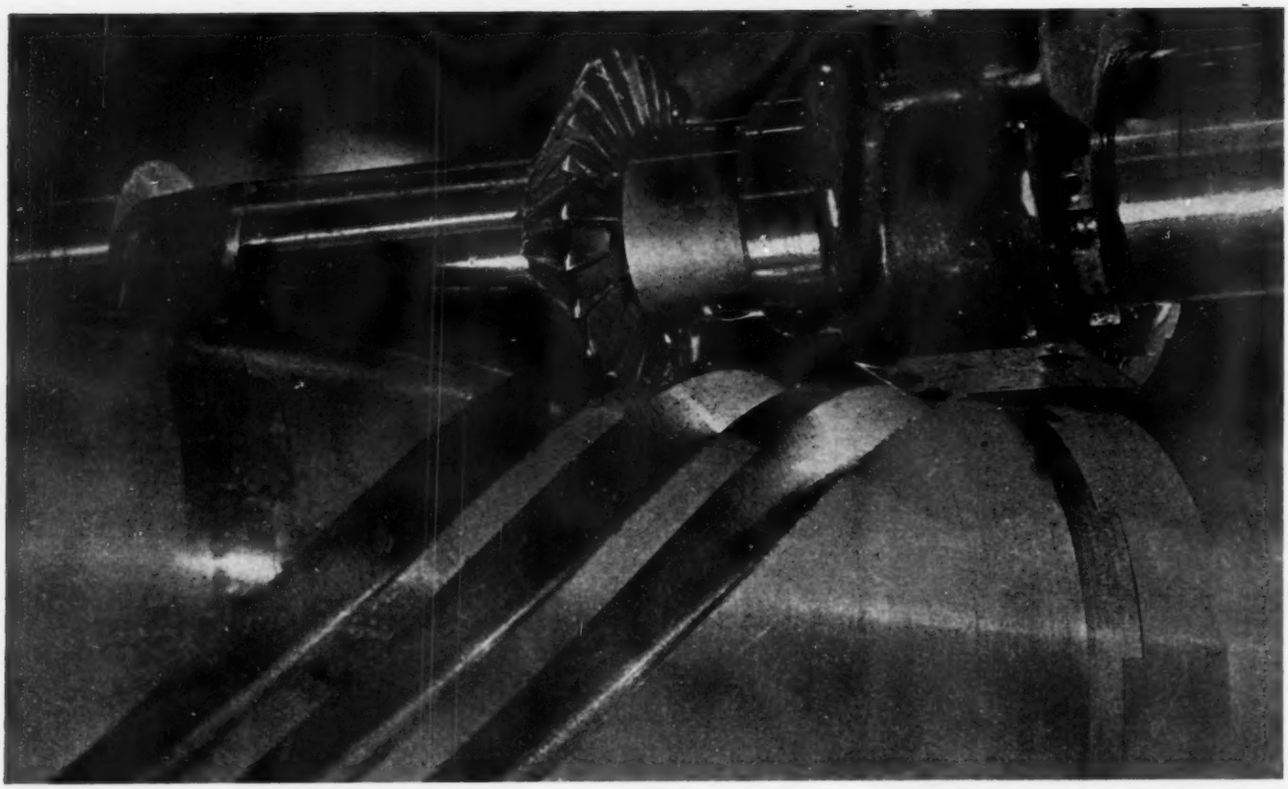
Monarch-Keller—For form turning, boring and facing. Incorporates many advancements which make it the most universal machine ever engineered.



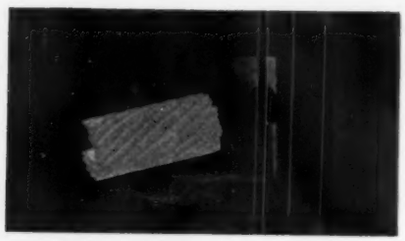
Monarch Engine Lathes—available in these sizes: 12", 14", 16", 18", 20", 22", 24", 27", 30" and 36".

M O N A R C H L A T H E S

Chicago Sales Office: 622 W. Washington Blvd.; Indianapolis Sales Office: 3115 North Meridian Street; Newark Sales Office: 1060 Broad Street; Pittsburgh Sales Office: 604 Chamber of Commerce Bldg.



ACCURACY . . .



cuts cutter costs

Here is the same large cutter coming out of a furnace during heat treatment. Metallurgy is a controlled science at Pratt & Whitney. Every step is laboratory directed and electrically controlled. That is why our tools are *uniformly* good.

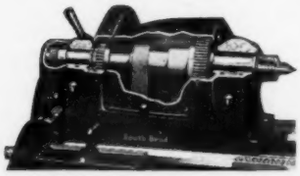
THE big cutter being milled in tne photo above is a Pratt & Whitney cutter. The little one doing the milling is a Pratt & Whitney cutter. We *have* to use accurate tools. We insist on top performance . . . maximum cuts per grind . . . accurate profiles . . . hard, tough alloy steels. We know as well as you do that only good cutters give satisfactory results. *So we use our own* . . . the same in every way as those we sell to industry. Precision methods have reduced *our* costs . . . these methods have made it possible for *you* to buy better cutters for less.

You can get Pratt & Whitney milling cutters in all kinds and sizes. Tell us your needs and let Pratt & Whitney accuracy cut your cutter costs.

PRATT & WHITNEY

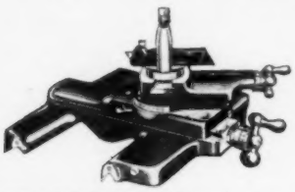
Division **Niles-Bement-Pond Company · West Hartford, Connecticut, U. S. A.**

Precision is Assured IN A SOUTH BEND LATHE

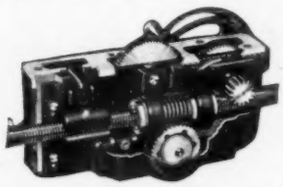


HEADSTOCK. Cutaway view showing integral type bearing and the capillary oiling system.

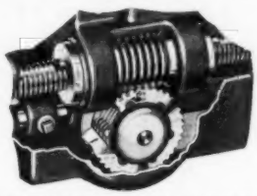
SUPERFINISHED SPINDLE is made of alloy steel with bearing surfaces carburized, hardened, ground and superfinished.



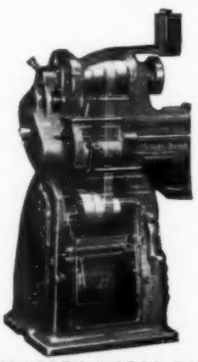
IMPROVED SADDLE and compound rest with adjustable tapered gibs. Cross slide bridge is wide and deep, providing rigid support for the tool rest.



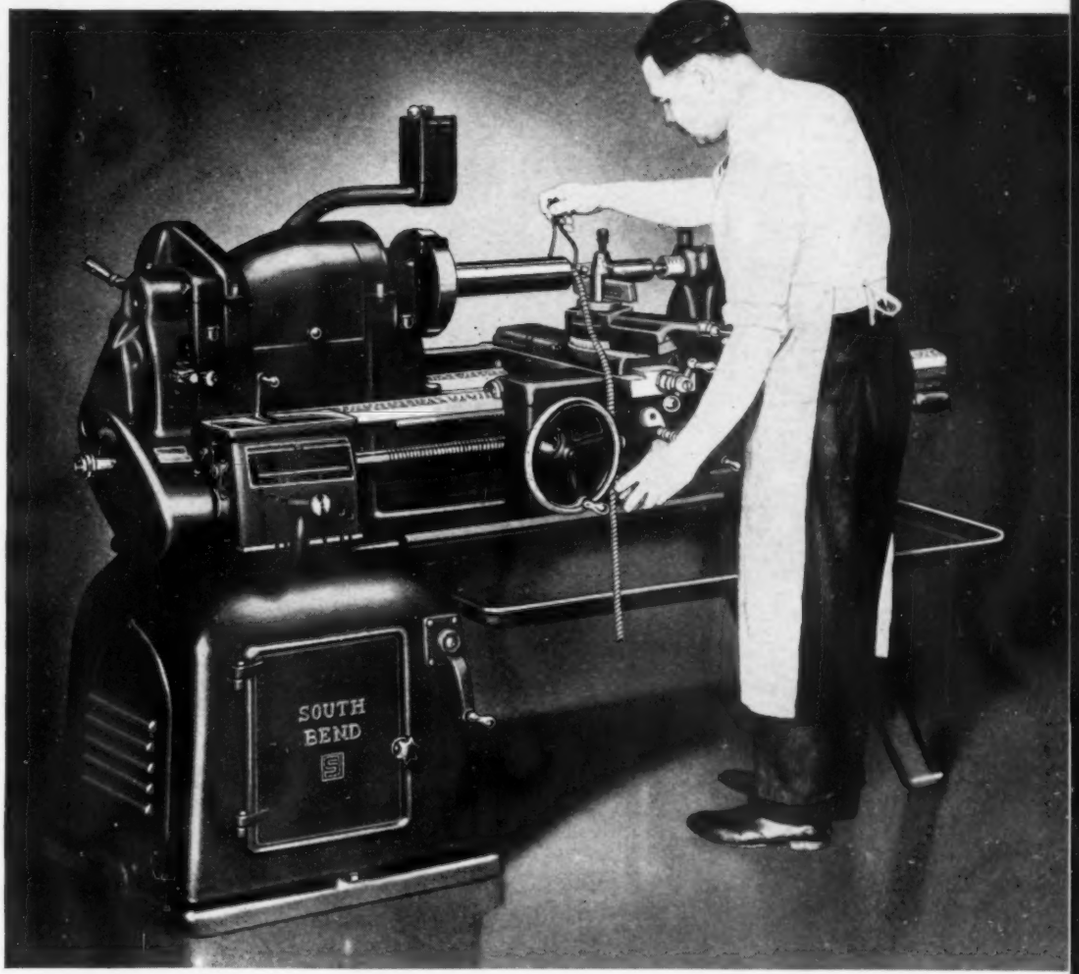
DOUBLE WALL APRON is rigid box type construction with all steel gears running in oil bath.



MULTIPLE DISC CLUTCH. Cutaway view shows alternate keyed steel disc construction.



UNDERNEATH MOTOR DRIVE. Belt drive to spindle is smooth and powerful and provides a wide range of spindle speeds.



PRECISION is assured in South Bend Lathes by combining fine workmanship with sound machine design. Expert mechanics, skilled by years of experience, fit and test each unit with a degree of exactness known only to the machine tool builder.

South Bend Lathes are used in the tool and gauge departments of nationally known manufacturers for the most exacting classes of precision work. They are also used for production operations on interchangeable parts requiring a high degree of accuracy. Conveniently located controls assure an ease of operation which reduces operator fatigue, resulting in a uniformly efficient rate of production over a long period of time.

South Bend Lathes are manufactured in over 65 sizes and types. Popular sizes are available for prompt delivery from dealer display stocks in important cities throughout the world. Made in 9", 10", 13", 14½", and 16" swing, in 3' to 12' bed lengths, in Countershaft and Motor Drives.

ON DISPLAY IN ALL PRINCIPAL CITIES

Baltimore, Md.—Carey Machinery Supply Co.
Boston, Mass.—South Bend Lathe Works**
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Chicago, Ill.—South Bend Lathe Works*
Cleveland, Ohio—Reynolds Machinery Co.
Houston, Tex.—Wessendorff, Nelms & Company
Los Angeles, Cal.—Eccles & Davies Mach. Co.
Milwaukee, Wis.—W. A. Voell Machinery Co.
Newark, N. J.—J. R. Edwards Machinery Co.
New York, N. Y.—A. C. Colby Machinery Co.
Philadelphia, Pa.—W. B. Rapp Machinery Co.
Pittsburgh, Pa.—Tranter Manufacturing Co.
Portland, Ore.—Portland Machinery Company
Providence, R. I.—Geo. T. Reynolds & Son
Rochester, New York—Ogden R. Adams
San Francisco, Cal.—Moore Machinery Co.
York, Pa.—York Machinery & Supply Company

* Chicago Sales Office: Room 308; Machinery Sales Building, Phone State 7283
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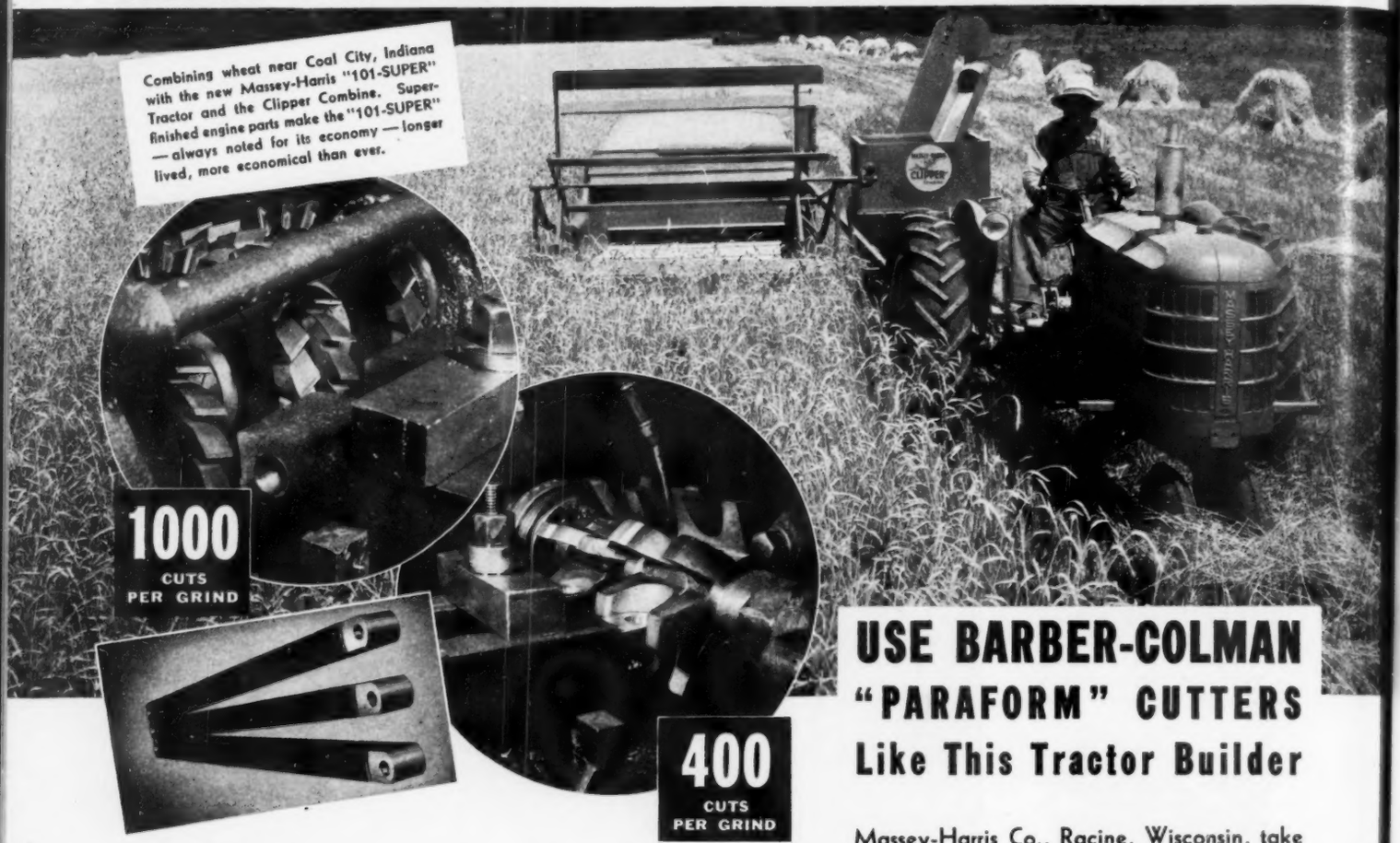
SOUTH BEND LATHE WORKS

LATHE BUILDERS SINCE 1906

959 E. Madison St., South Bend, Ind., U. S. A.

TRADE MARK SOUTH BEND TWIN ENGINE LATHES

WANT TO LOWER YOUR MILLING COSTS?


Combining wheat near Coal City, Indiana with the new Massey-Harris "101-SUPER" Tractor and the Clipper Combine. Super-finished engine parts make the "101-SUPER" — always noted for its economy — longer lived, more economical than ever.
1000
CUTS
PER GRIND
400
CUTS
PER GRIND

USE BARBER-COLMAN "PARAFORM" CUTTERS Like This Tractor Builder

Massey-Harris Co., Racine, Wisconsin, take full advantage of these savings in building fine tractors.

Operation No. 1 employs four "Paraform" Side Mills, which machine top and bottom of two front axles at one time in 3 minutes floor-to-floor. Cutter performance is 1000 cuts per grind. In Operation No. 2, two Formed Milling Cutters round the ends of two axles in 15 minutes floor-to-floor, producing 400 ends, per grind. One man runs both mills besides a drill press.

The unique design of "Paraform" Cutters, plus their rigidly guarded high quality, and precision sharpening on Barber-Colman sharpening machines, accounts for this record performance.

Do you want to know if B-C Standard "Paraform" Cutters will reduce your milling costs? Order a set for one of your jobs today, and try them out yourself. Standard "Paraform" Cutters are stocked for immediate delivery.

THE DATA

	OPERATION NO. 1	OPERATION NO. 2
Name of Part	Front Axle.	
Material	2" x 3" HRS; 180-190 Brinell hardness.	
Operation	Straddle Mill the ends of two front axles at a time.	Form Mill the ends of two axles at a time.
Machine	Gooley & Edlund Mill.	No. 3 Cincinnati Mill.
Cutters	Four 8½" x 1" x 2" Barber-Colman "Paraform" Side Milling Cutters.	Two 1¼" radius Barber-Colman Formed Cutters.
Holding	Screw clamps.	Screw clamps.
Stock Removed	Straddle Cut, 2.750"-2.740" x 2", removes 1 cu. inch stock from two sides of each end.	Forming Cut, 2" x 3" x 1¼" radius, removes 0.9" cu. inch from each end.
Feed	1.00" per min.; 0.045" per rev.; chip load, 0.042" a min. per tooth.	0.50" per min.; 0.0125" per rev.; chip load, 0.063" a min. per tooth.
Speed	22 r.p.m.; 48 surface feet.	41 r.p.m.; 65 surface feet.
Production Time	2 minutes cutting and 1 minute loading per end.	14 minutes cutting and 1 minute loading per end.
	(Total time per piece 18.86 minutes. One man operates both millers and a drill press, and governing time is on Operation No. 2)	
Pieces per Grind	500 (Milled on both ends).	200 (Milled on both ends).

BARBER B-C COLMAN PRODUCTS
HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

Consult your Catalog K for information on B-C Cutters, Hobs, and Reamers. If you are having cutter difficulties, consult your Barber-Colman Cutter Engineering Service. There is no charge or obligation for recommendations.

Barber-Colman Company

General Offices and Plant 201 Loomis St., Rockford, Illinois, U. S. A.

Resolutions make Revolutions

Surest way for your company to enjoy a happy New Year is to avail yourself of new LeBlond machine tools at your first opportunity. Yes, turning to LeBlond with your turning problems is a resolution that will get you more revolutions than you ever dreamed possible . . . more revolutions for faster production . . . accurate revolutions for precision tooling with less scrap loss. Two kinds of revolutions progressive plants can use every day of the week.

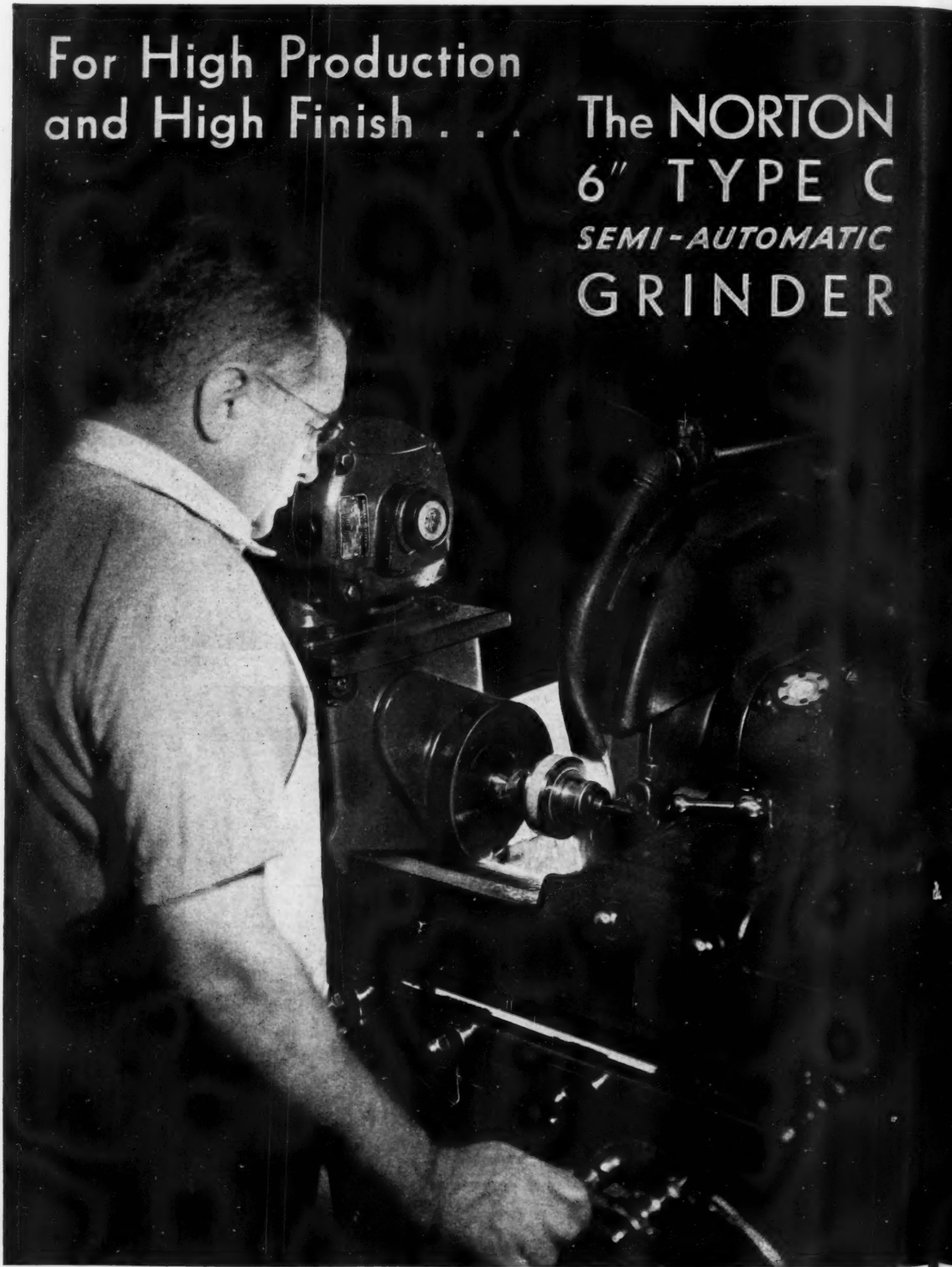
Write it down if you like, but please don't forget it. For a resolution engraved in your mind, is worth two tossed in the waste basket. The R. K. LeBlond Machine Tool Co., Cincinnati, Ohio.

Chicago Office: 20 North Wacker Drive, Phone STate 5561; *New York Office:* 103 Lafayette Street, Phone CAnal 6-5281.

LeBlond manufactures Engine Lathes • Super Regal Lathes • Rapid Production Lathes • Bed Gap Lathes • Sliding Bed Gap Lathes • Cutter Grinders • Hollow Spindle Lathes • Crankshaft Lathes • Multi-Cut Lathes • Tool Room Lathes.

LEBLOND
CINCINNATI, OHIO
U.S.A.

★Largest Manufacturers of a Complete Line of Lathes!


For High Production
and High Finish . . .
The NORTON
6" TYPE C
SEMI-AUTOMATIC
GRINDER

EQUALLY economical for mass production or for small lots, Norton Type C Semi-automatics are day by day building an enviable reputation as reliable, accurate and easy-to-operate plunge-cut grinders. Consider these features:

Flexibility—Set-up or change-over easily and quickly made

Convenience—One lever controls all of the major machine functions

Simplicity—Adjustments for size and rate of feed are at the operator's finger tips

Optional Cycle—Automatic or operator-controlled or both

Traverse Arrangements—By hand or by power or both if desired

Norton Semi-automatics are exceptionally accurate and some truly phenomenal production rates have been established.

M-431

NORTON
GRINDING MACHINES

NORTON COMPANY
WORCESTER, MASS.

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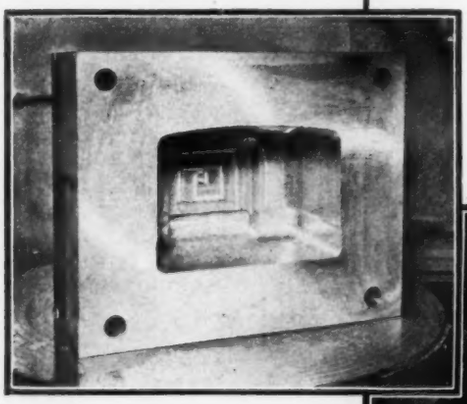
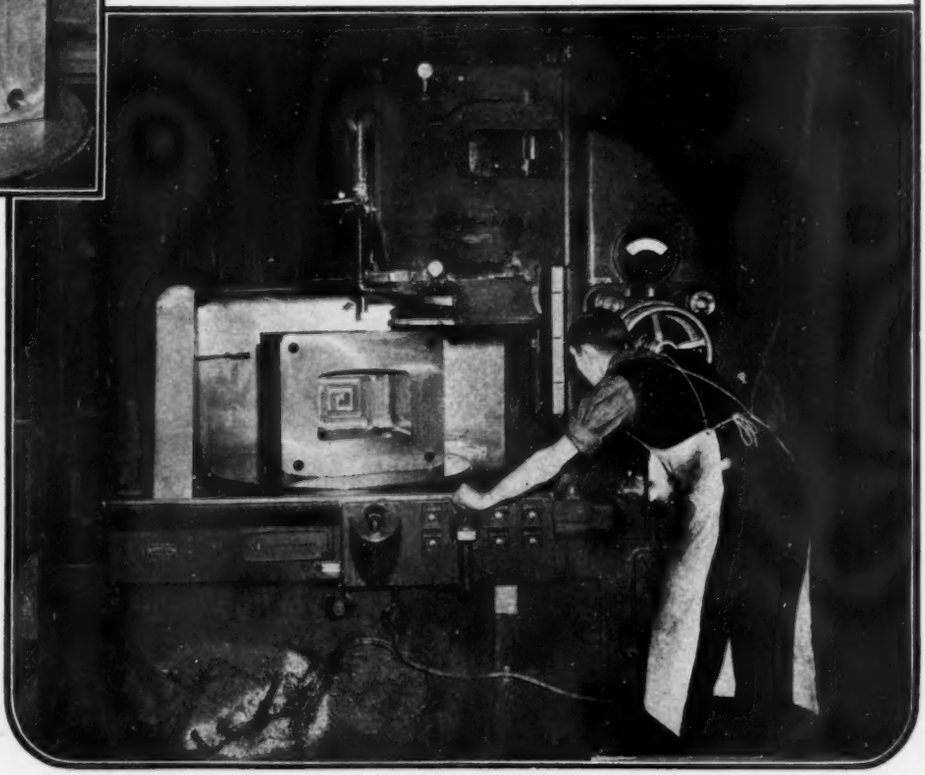
"We used to shape our plate stock at a cost of 4¢ to 5¢ per square inch—now we grind it on a Blanchard No. 18 at a cost of less than 2¢ per square inch."

THAT is what one leading die manufacturer said about his costs—and what scores of others are saying about Blanchard Grinding. They use their Blanchards for machining flat surfaces on die bases, punch holders, stripper plates, sectional die parts, drawing dies and hold downs, blanking dies; also on die blocks for forging, die casting and plastic molding.

The Blanchard No. 18 Surface Grinder and wheels manufactured by Blanchard are the ideal combination for reducing the cost of machining flat surfaces. The Blanchard No. 18 catalog and booklet "Work Done on the Blanchard" give the whole story. Send for your copies today.

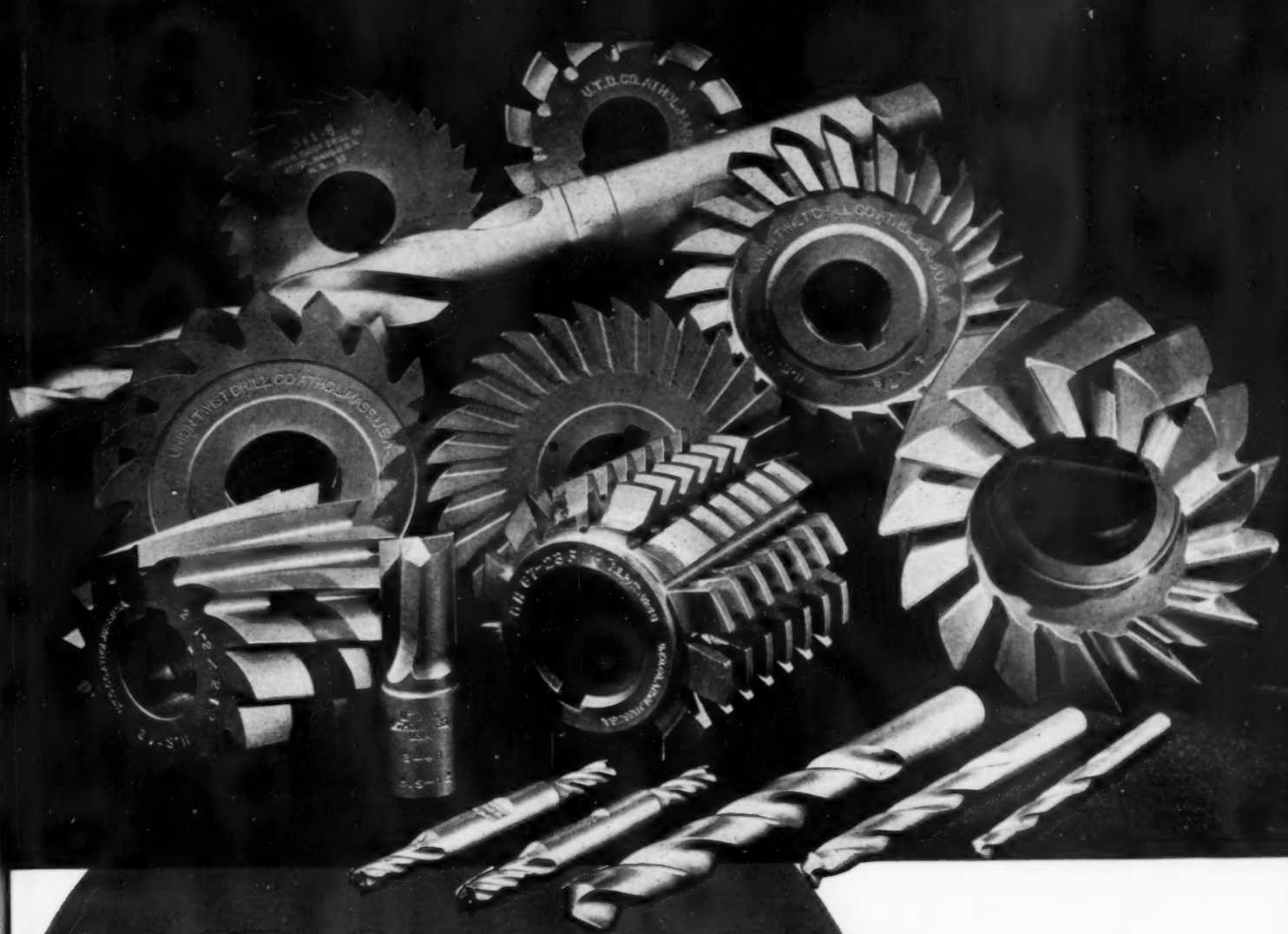
The cost of finishing the outer surfaces of this radio cabinet die, 18" x 22" x 11", 1/16" stock per side, was cut in half when ground on the Blanchard No. 18, using Blanchard Sectored Wheel.





BLANCHARD

BLANCHARD MACHINE CO.
64 STATE STREET
CAMBRIDGE, MASS.



UNION

THE TOOLS YOU BUY AGAIN

Every tool in the complete Union line is the result of expert selection of steels . . . skilled design . . . painstaking Craftsmanship . . . and a single unwavering standard of quality. Choose your tools with these factors in mind and we're sure that Union will be — The Tools You Buy Again.

UNION TWIST DRILL CO., Athol, Mass.

S. W. CARD MFG. CO. DIV., MANSFIELD, MASS.
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MILLING CUTTERS
GEAR CUTTERS — HOBS — SAWS
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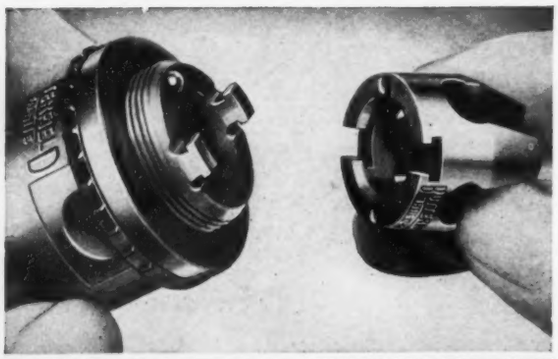

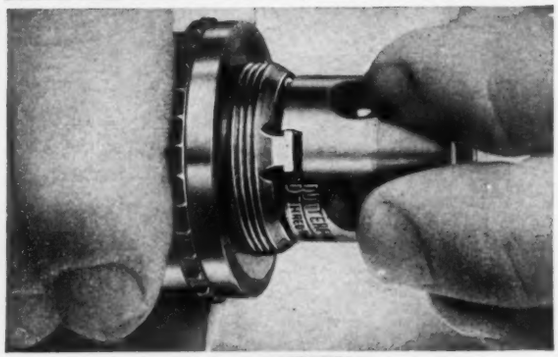

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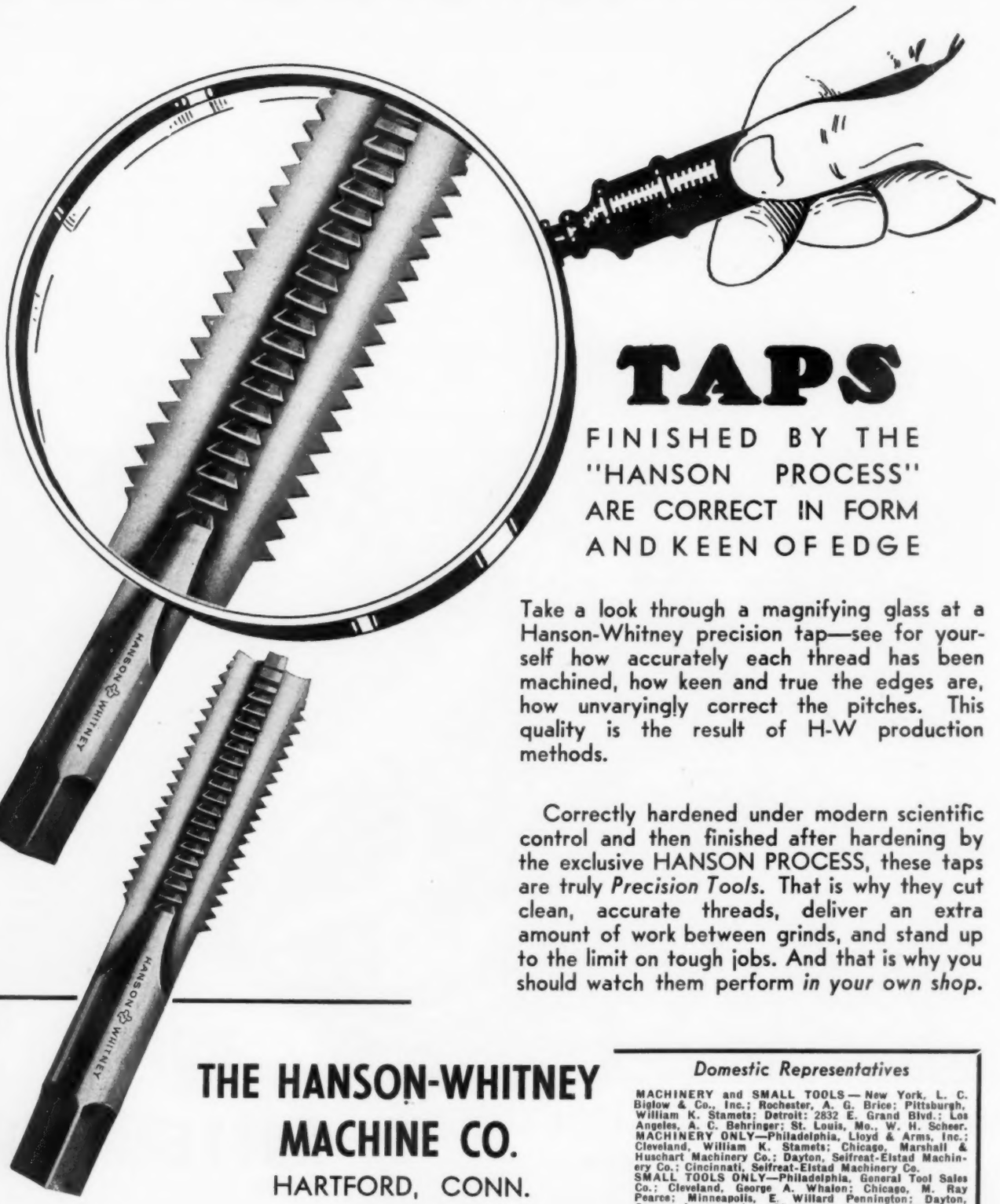

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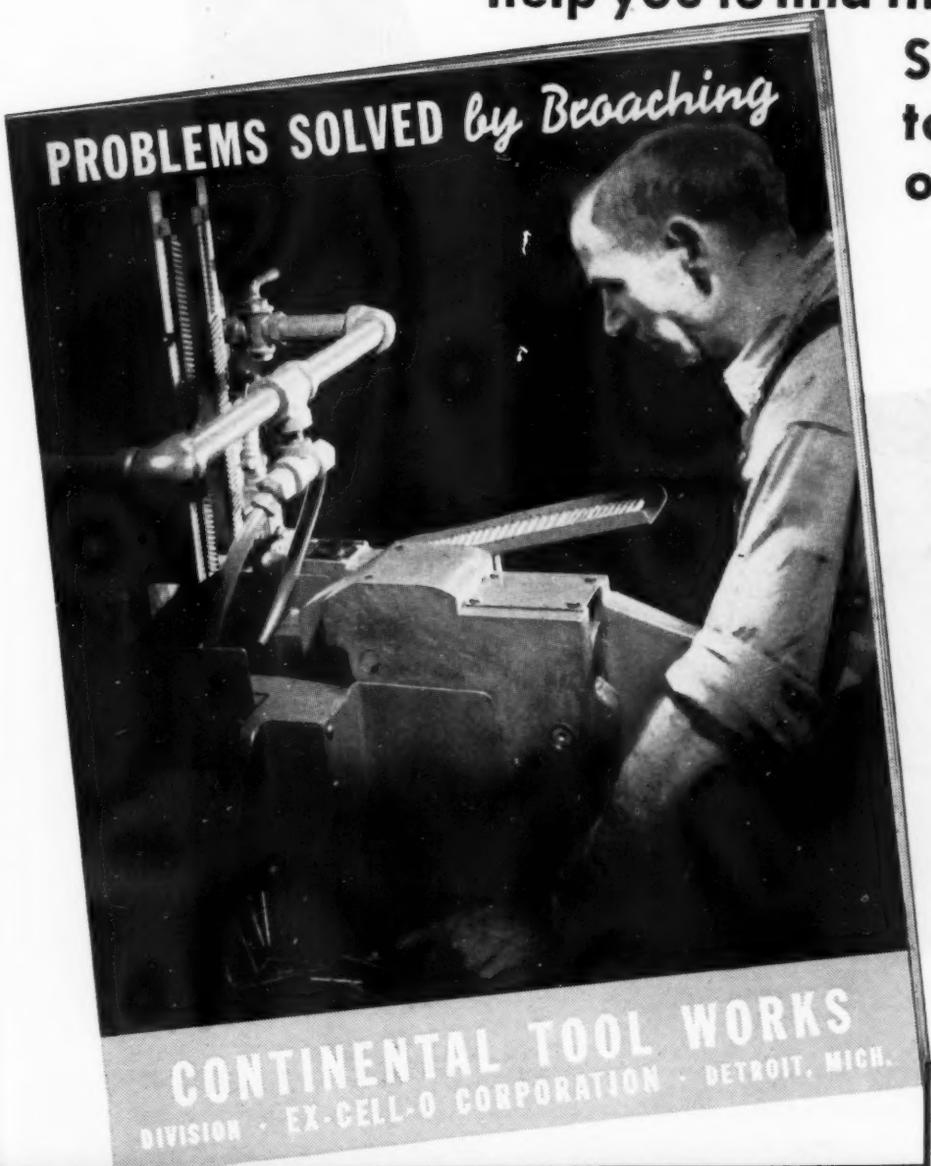

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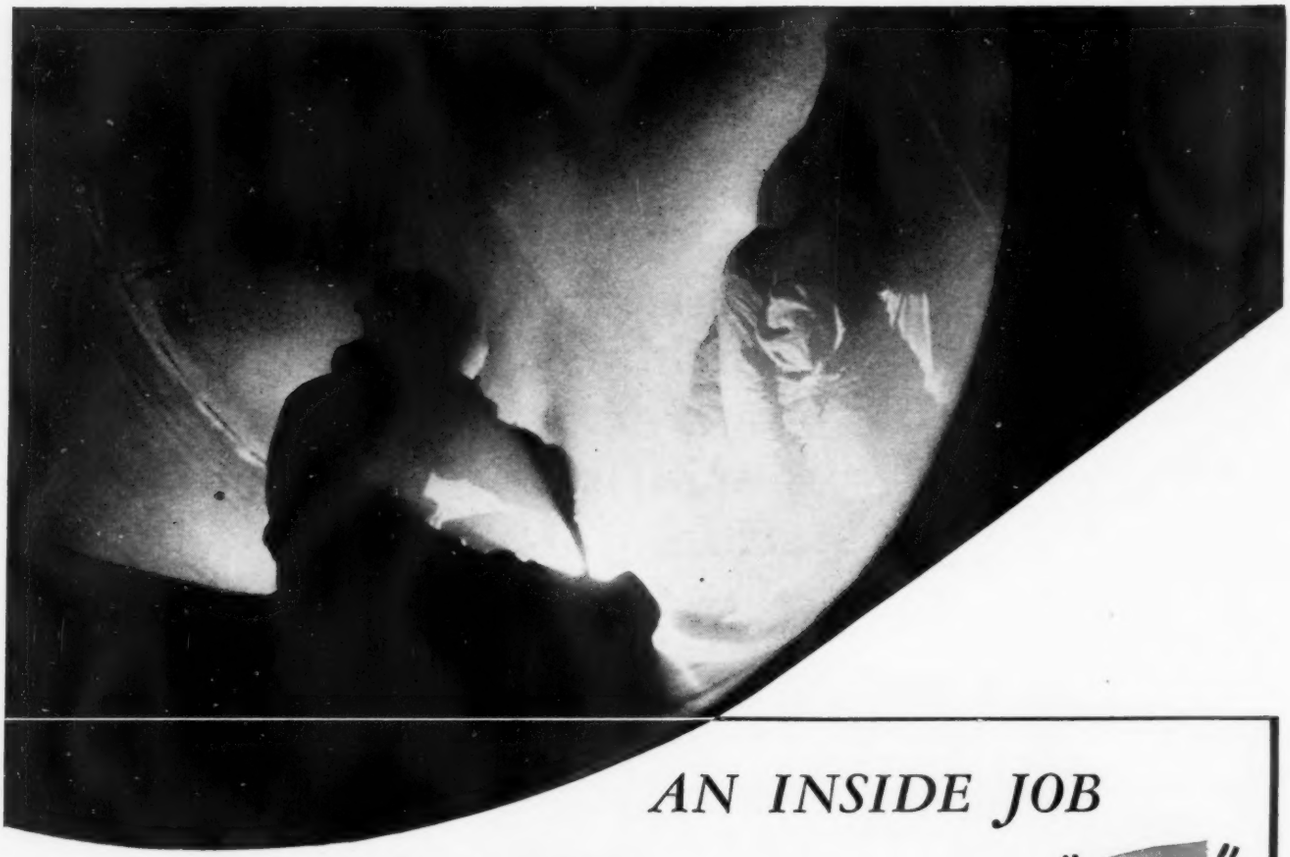

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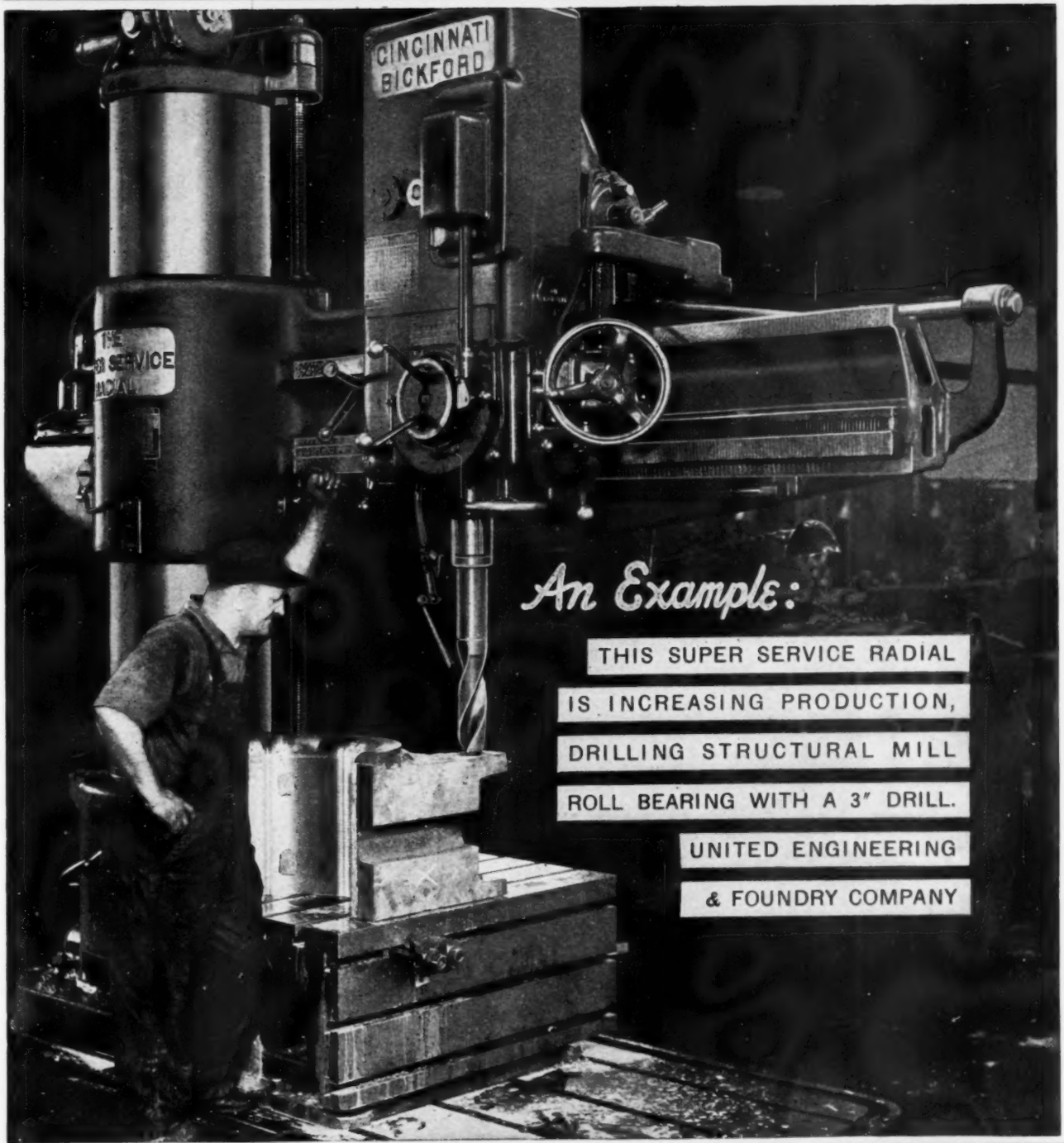

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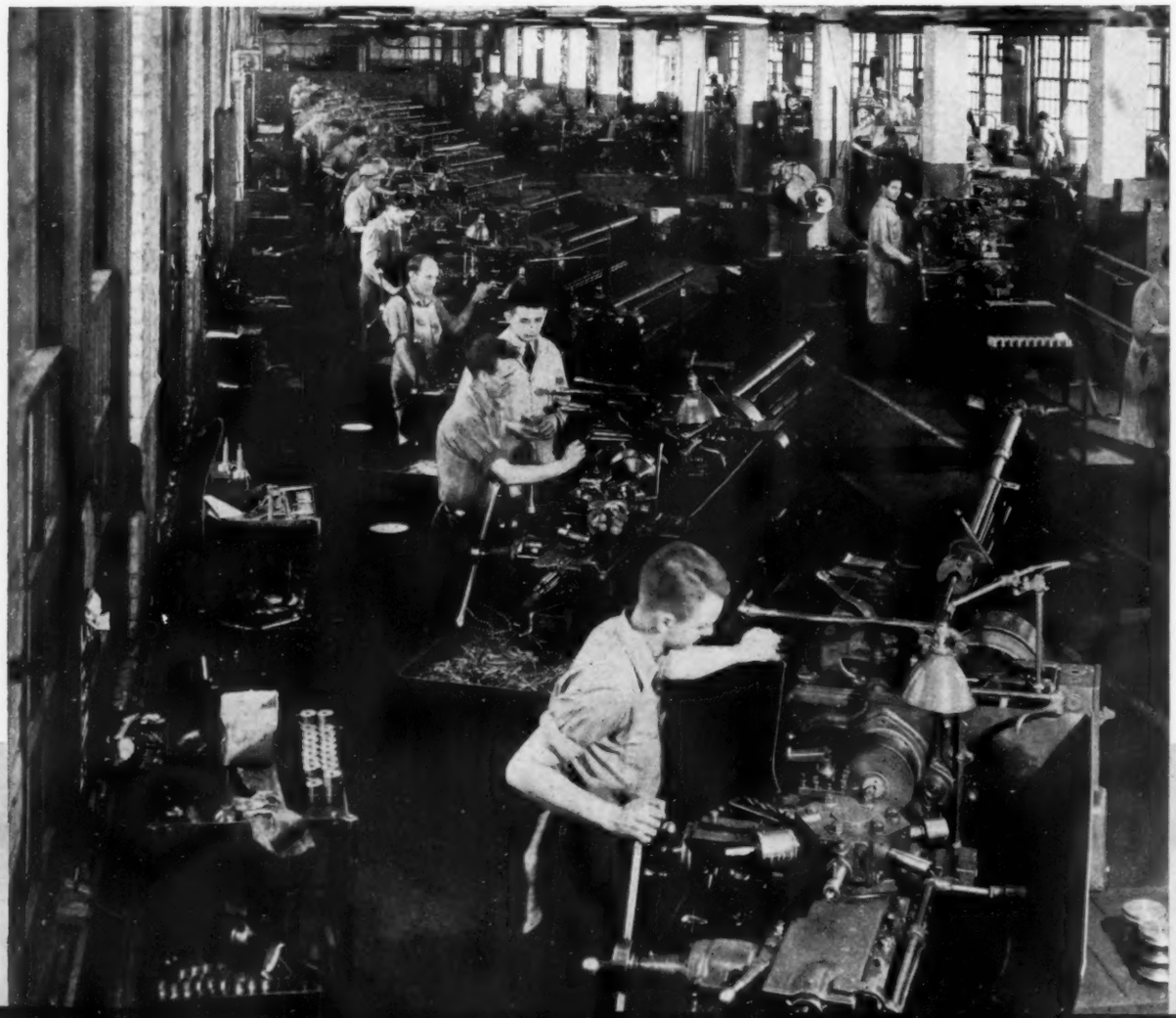

WHAT'S IN THIS ISSUE

CANADIAN CONTRIBUTIONS

With the British pushing their recent gains, it is only fitting that in this issue we dedicate the Armament Section to Canada's efforts to aid England in her hour of need. For, to an island nation beleaguered by bombs from the air and shells from France, production in centers beyond the reach of enemy guns and planes assumes ever-increasing importance. It is indeed gratifying to detect brief news items of Canadian-made guns and munitions getting in effective work against the totalitarian powers. Canada, truly, carries on.

As you will learn in greater detail from "Anti-Aircraft Gun Barrels," which begins the section labeled "Canada Carries On," typical metalworking companies in the Dominion have been setting somewhat of a record in getting into production for munitions items. For instance, a plant having no previous experience in making the Bofors gun passed the first completed barrel through inspection only fourteen weeks after production was begun. At no time has it fallen below its quota. The story of this achievement begins on page 1070.

SHELL FORGINGS

Also under the "Canada Carries On" heading of this number's Armament Section is what we consider a bang-up article on forging 3.7-in. shell. The methods employed are tried and proved over long service. Production is well over 100 forgings per hour per unit, which is not to be sneezed at. With so many U. S. concerns taking on additional defense work, much of it on shell and shell forgings, we feel you'll be tremendously interested in the story beginning on page 1080, entitled "3.7-In. Shell Forgings."

INSIDE AN ARSENAL

While Canada's private industry is doing its best to share the load of supplying England's forces with machines of war, the Dominion Arsenal is far from idle. Products of this arsenal include small arms ammunition and cartridge cases for the smaller sizes of artillery ammunition. From a recent peacetime low it has quickly jumped to true mass-production of ammunition while other facilities are in the process of preparation. Details of the methods employed are given in "Bullets for Britain," which starts on page 1087. All the facts in this story, as well as the other two in the "Canada Carries On" section, were prepared with the full cooperation of the Canadian government and passed by the Canadian censor.

STOP SABOTAGE

Recent fires, explosions and miscellaneous plant disasters have naturally raised the cry of sabotage in the lay press. Coincidence or not, it is in times of increasing production and general expansion that such disasters are most likely to occur. Next in violence to an explosion ranks fire, which can wipe out thousands of dollars worth of new plant, equipment and work in progress in the time it takes the fire department to arrive. All fires start as little ones, and if they can be put under control immediately only slight damage may result. Hence we recommend Leonard F. Maar's story on page 1059. As a member of the Safety Research Institute, Mr. Maar has proposed a logical, simple system of extinguishing plant fires when they're mere flickers.

BLANK

On page 1060 the series on the cold working of sheet aluminum continues with its second installment devoted to the blanking of sheet stock. This particular article, written by J. T. Weinzierl and A. C. Heintz of the Aluminum Company of America, gives detailed recommendations for eliminating troubles and stepping up output.

J. T. WEINZIERL
AND A. C. HEINTZ
. . . bigger, better blanks

Line drawings help explain the various points, while tables provide actual operating data as to die clearances, scrap allowances, and so on.

LONGER LIFE

With every effort being made to get the utmost out of machine tools, the problem of tool life naturally becomes of increasing concern. Especially with the accuracy of many machine set-ups dependent upon the tool's resistance to wear, the question of tool life becomes of still greater

GEORGE M. CLASS
. . . for longer life

importance. Therefore we know you'll get a lot of useful information out of George M. Class's article on page 1055. Mr. Class is vice-president of Gisholt Machine Company, and his long experience with tooling high-production machines has enabled him to cram much data and sound advice into his article. In it, too, you'll find helpful formulas and clear diagrams.

COMING

So long as the present national defense emergency continues, you can count on educational munitions articles in AMERICAN MACHINIST'S Armament Section. Scheduled for the next number are a description of the manufacture of various parts for the Browning 30-calibre machine gun and a trip through the Rock Island arsenal. Also planned is an article outlining the proper care of broaches, and, of course, the next installment in the series on the cold working of sheet aluminum. You'll find them in the January 8 AMERICAN MACHINIST.

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ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

Tool life in metal turning

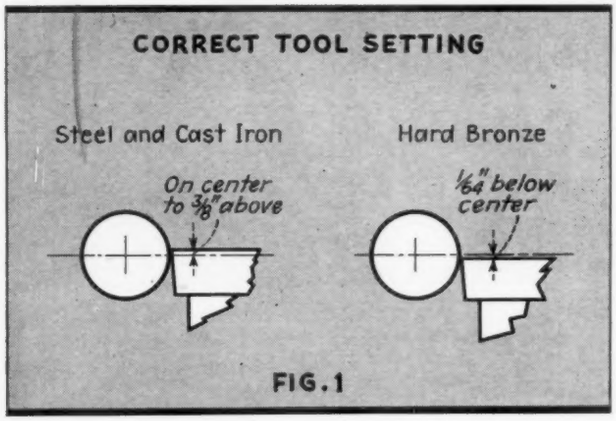


Fig. 1—Tool overhang must be kept at a minimum, with the cutting edge in proper relation with the work

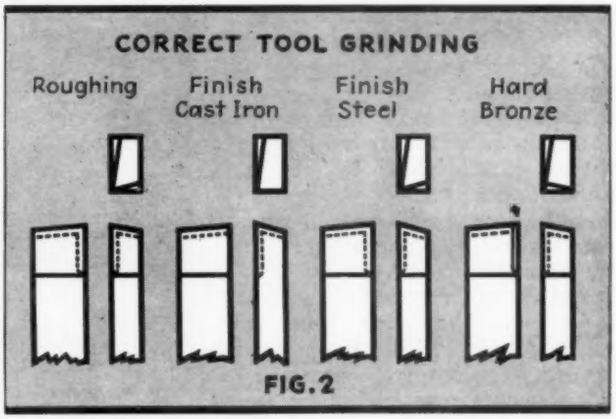


Fig. 2—In general, tool shapes like those shown above work well when cutting the materials indicated

BY GEORGE M. CLASS, VICE-PRESIDENT, GISHOLT MACHINE COMPANY

Cutting speeds which result in 4-hr. life of single-point tools can be calculated by using simple formula. Results check with experience in the field

IN GENERAL, the efficiency of metal turning equipment can be judged by the life of the cutting tool and its ability to remove metal during that time. Life of the tool is affected by the machine on which it is used, method of mounting the tool, condition of the cutting edge, material being machined, finish desired, cutting lubricant used, feed and cutting speed.

Best results can be obtained only when the machine is sufficiently powerful, rigid and accurate to withstand strains caused by the cutting operation. This is especially true with cutting tools which will take higher cutting speeds and rates of feed than are possible with high-speed tools. In the application of cemented carbide tools it often has been found that the power of the machine was not sufficient to maintain the most desirable cutting speed, particularly with several tools cutting at the same time.

Cutting tools must be mounted rigidly. A substantial holder should be used, and the tool overhang must be kept at a minimum. Fig. 1 shows how the tool should be set in the holder for best work and finish when turning steel, cast iron and hard bronze. In the first two cases, it should be placed either on the center of the work or slightly above it to prevent chattering. On large diameter work, the tool frequently is placed as much as $\frac{3}{8}$ in. above the center, where it will operate more successfully than if it were on the center. On the other hand, for hard bronze the tool usually is set below center.

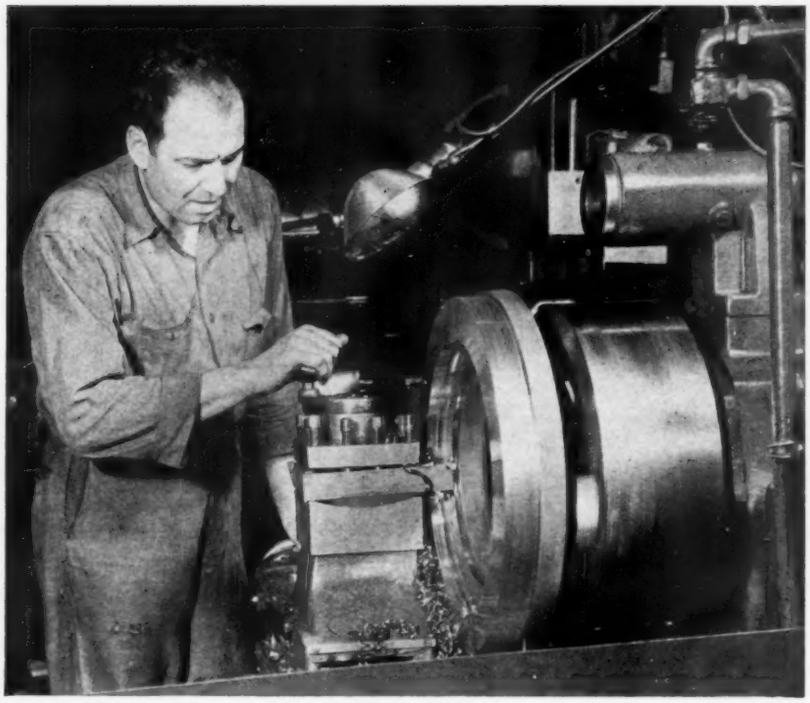
Machine grinding of the cutting edge of the tool is preferable to hand grinding. The face of a cup wheel or the flat side of a wheel is best for grinding the finish clearance angles, so that a curve is not ground in the tool which would reduce its strength. A minimum face angle and end clearance angle are desirable, as is a top rake angle sufficient to make a good cutting edge. For roughing tools, a large nose radius should be used wherever possible with a slight lead angle on the face, about 15 deg. This protects the point of the tool on roughing work where the brunt of the chip load is taken by the body of the tool. Since the main object of roughing is to remove metal, and the series of grooves produced later is removed by a finishing cut, a round nose tool is preferred. The round nose distributes the cutting edge around a greater portion of the tool and so gives it a longer life.

Finishing tools for cast iron and non-ferrous metals usually have

enough land to overlap the feed per revolution, thus producing a very smooth finish since the cutting edge passes over the same surface twice. Finishing tools for steel generally have a slight radius on the point. To give the cutting edge of the tool good support, it is desirable to reduce the front and side clearance angles as much as possible. The top rake angle should be as great as possible, in order to give free cutting action, permitting the tool to cut the metal off instead of pushing it off. Fig. 2 shows the general shape of tools for cutting cast iron, steel and hard bronze. Cemented carbide tools will produce a better finish, and time between grinds will be lengthened, if they are diamond lapped after being finish ground.

It is not uncommon to run for days without grinding the tools when cutting aluminum, whether they be high-speed steel or cemented carbide. However, when cutting some of the hard alloys, such as SAE 4350 or high-carbon car wheel steels, it is possible to run only 30 to 60 min. before regrinding the tools. Here the cemented carbides frequently have shown a considerable saving over high-speed steel tools. Every metal has a maximum speed at which it can be removed most efficiently. When this cutting speed is reached, the chip will be cut from the piece and not be sheared or pushed off.

For single-point tools, finish improves as the speed increases and the feed is decreased. When turning steel or cast iron with regular high-speed steel tools, the maximum cutting speed available which will still leave a cutting edge on the tool is not high enough to produce a smooth finish on the work. Instead of actually cutting the metal, the tool pushes it off in a series of tears. The surface may look smooth to the eye, but examination with a magnifying glass will show the tears to be quite pronounced. Using tools capable of operating at higher speeds will give smoother and more accurate finishes.



Metal can be removed quickly at reasonable cost when proper cutting materials are used in modern, efficient machine tools. Here a cemented carbide tool is taking a ½-in. cut in a SAE 1045 forging. Surface speed on the 15 in. diameter is 388 ft. per min. with an 0.0175 feed

Finish and feed are interdependent. The coarser the feed, the rougher the finish and the shorter the tool life. However, tool life can approach a satisfactory amount by using the proper combination of speed and feed, such as a slow speed and a coarse feed for roughing cuts, and a high speed and a fine feed on finishing cuts.

Tool life can be increased as much as 20 to 25 per cent by using a cutting lubricant when machining steels. This also applies to cast iron in a majority of cases, since the oil keeps the tool cool as well as acting as a lubricant between chip and tool. Most commonly used types of cutting lubricant are soluble oil, lard oil, thread-cut oils and kerosene-base lubricants for use with aluminum. One part of soluble oil mixed with six parts of water is satisfactory on most work. A cutting oil is used with cemented carbide tools principally to keep the work cool. It does not matter how hot a cemented tool becomes, just as long as the braze between the bit and the shank does not melt.

Whenever a lubricant is used, the tools should be liberally flooded, and the supply of lubricant should be turned on before the cut is started. This is especially necessary when Stellite 2400 or cemented carbides are used. These tools are sensitive to violent temperature changes and may crack if they are rapidly cooled.

The cutting speed can be so high that the tool will burn up quickly, or it can be so low that the tool life will be exceedingly long. As a rule, when tools are not difficult to reset, cutting speed should be such as to give about a four-hour life on roughing cuts and four to eight hours on finishing cuts. This does not necessarily hold true for cemented carbide tools since, in many cases, they last several days without grinding.

The relation between cutting feed and tool life, under constant cutting conditions, follows the formula

$$CT^b = X$$

where: C = cutting speed measured on the uncut surface of the work, ahead of the tool, in ft. per min.; T = tool life between grind in min.; X = a constant; and b = an experimentally determined constant.

The values for b determined from best available data are shown in Table I. When using the above formula, it is necessary to make a test cut, using a cutting speed high enough to cause rapid tool failure. Between 5 and 20

Table I—VALUES FOR CONSTANT "6" FOR DIFFERENT TOOLS AND MATERIALS

Tool and Material Cut	Chip Thickness (Feed) Less than 0.015 in.	Chip Thickness (Feed) Greater than 0.015 in.
Carbon Tool Steel		
Steel	0.075	0.200
Cast Iron	0.075	0.075
High Speed Steel		
Steel	0.100	0.125
Cast Iron	0.100	0.100
Brass, Bronze	0.290	0.290
Stellite		
Steel	0.140	0.180
Cast Iron	0.140	0.140
Cemented Carbide		
Steel	0.130	0.160
Cast Iron	0.130	0.130

min. is satisfactory. The following example is based on an actual test using Stellite on cast iron:

$C = 250$ ft. per min.
$T = 15$ min.
$b = 0.14$ (see Table I)
$X = CT^b$
$X = 250(15)^{0.14}$
$X = 365$

To find the cutting speed for 4-hr. tool life under the same cutting conditions as the test cut:

$T = 240$ min.
$C(240)^{0.14} = 375$
$C = 158$ ft. per min., the required cutting speed for 4-hr. tool life.

If cutting speed were increased to 175 ft. per min., the tool life would be:

$175(T)^{0.14} = 365$
$(T)^{0.14} = 365/175$
$T = 165$ min. or $2\frac{3}{4}$ hr.

Cutting speeds for 4-hr. tool life calculated by the above method for various metals are summarized in Table II. These speeds are based on information obtained from many of our own tests, and from actual jobs in many shops. The values given are based on continuous cuts using different combinations of feed and depth of cut, with different kinds of cutting tool materials.

The recommended speeds are based on the use of cutting oils. Along the

Table II—SUGGESTED CUTTING SPEEDS FOR TURNING TOOLS

MODIFICATIONS	MATERIAL TO BE MACHINED	H.S.S.	SUPER H.S.S. (COBALT)	STELLITE J	STELLITE 2400	CEMENTED CARBIDE
CONTINUOUS CUT WITHOUT LUBRICANT. DECREASE CUTTING SPEED 25 %	X1112	44-161	57-195	69-246	85-310	253-630
" 15 %	1112	33-122	44-149	52-187	77-236	192-479
" 40 %	X1314 - X1315	29-105	37-127	45-160	55-202	165-411
	1115 - 1120	27-100	36-121	43-153	53-193	157-391
	X1015 - X1020	26-96	34-117	41-146	51-185	151-375
	X1330 - 2015 - 2115	25-93	33-113	40-142	49-180	146-364
" " "	1010 - 1015 - 1020 - 1025 - 1045 A X1335 - 3115 - 3120 - 3130 A - 4815 4820 - 6130 A	24-88	31-107	38-135	47-170	139-345
" " "	1030 - 1035 - 1050 A - X1340 2330 A - 2335 A - 3135 A - 5140 A 6135 A - 6140 A - HYTEN A TEMPER NO. 1 - HYTEN B2	23-86	31-104	37-132	45-166	135-337
" " "	X1025 - X1040 - X1050 A - 2315 2320 - 3140 A - X4130 - 4135 A 4140 A - 4615 - 4620 - 6115 6145 A - HYTEN A TEMPER NO. 15	22-82	29-100	35-125	43-158	129-320
" " "	1040 - X3140 A - 3145 A 3215 - 3220 - 3230 A - 3415	21-78	28-94	33-119	41-150	122-304
" " "	X1045 - 3150 A - 3312 - 4150 A 4340 A - 4345 A - 4640 A - 5120 5150 A - 6120 - 6150 A - HYTEN B3X	20-73	26-89	31-112	39-142	115-288
INTERMITTENT CUT WITH "	1045 - 2340 A - 3125 - 3130 - 3230 3240 A - 4340 - 4345 - 4640	19-70	25-85	30-107	37-135	110-274
" WITHOUT "	1050 - 2330 - 3135 - 6125	18-67	24-81	28-102	35-128	105-260
" " "	X1055 A - 1055 A - 1060 A - 1065 A 2335 - 2345 A - 2515 - 3140 3150 A - 6130 - HYTEN B4	17-64	23-77	27-97	34-123	100-248
" " "	X1065 A - 1070 A - 1075 A - 1080 A T1330 - T1335 - T1340 - T1345 - 2340 2350 A - X3140 - 3150 - 3240 A 3245 A - 3250 A - 3325 - 3335 A 3340 A - 3435 A - 3450 A - 9255 A	16-60	21-72	25-91	31-115	93-233
" " "	1085 A - 1090 A - 1095 A - T1350 3240 - 3245 - 3250 - 3335 - 3340 3435 - 3450 - 9255	14-53	19-64	22-80	28-101	83-206
" " "	52100 A - 6195 A - 9260 A	13-48	17-59	21-74	26-93	76-189
" " "	STAINLESS STEEL - FREE MACHINING	20-73	26-89	31-112	39-142	115-288
25 15	STAINLESS STEEL - FREE CUTTING	30-112	40-136	48-171	59-216	176-438
15 15	CAST IRON - 160-180 BRINELL	40-130	52-168	64-203	70-223	126-396
15 15	CAST IRON - 227-247 BRINELL	28-92	36-123	45-156	50-172	72-249
15 10	MALLEABLE IRON - 100-140 BRINELL	52-169	67-220	83-270	91-297	148-474
25 20	CAST STEEL - 115-140 BRINELL	30-100	39-129	48-160	53-176	78-255
20 % 10 % 30 %	CAST STEEL - 140-160 BRINELL	26-92	34-120	41-148	45-163	67-240
	ALUMINUM	280-920	350-1150	350-1150	385-1265	420-1380
	YELLOW BRASS	85-312	105-375	140-500	154-550	175-625
	ORDINARY BRONZE	35-125	44-156	52-187	57-206	87-312
	HARD BRONZE	21-75	26-93	31-112	34-124	52-187
	COPPER	65-235	78-281	105-375	115-413	131-469
CONTINUOUS CUT WITHOUT LUBE. REDUCE SPEED 25 %	MONEL BAR STOCK 68 % NICKEL - 29 % COPPER 3 % OTHER ELEMENTS	24-185	27-204			
" " "	CAST MONEL METAL - 68 % NICKEL 29 % COPPER - 3 % OTHER ELEMENTS	26-120	29-132			

left-hand side of Table II are modifications applying to the use of the cutting speeds under certain conditions. For instance, in machining any of the materials listed with a continuous cut without a cutting oil, the speed should be decreased 25 per cent. An intermittent cut without a lubricant requires a 40 per cent reduction in cutting speed for most of the materials, but with a lubricant only a 15 per cent reduction is needed. The cutting speed may be increased 50 to 100 per cent on very light finishing cuts.

The cutting speeds given in the table are for a depth of cut ranging from $\frac{1}{32}$ to $\frac{5}{8}$ in., and a feed per revolution from $\frac{1}{64}$ to $\frac{1}{32}$ in. The $\frac{1}{32}$-in. depth of cut and $\frac{1}{64}$-in feed represent the high limit of cutting speed while the $\frac{5}{8}$-in. depth of cut and $\frac{3}{32}$-in. feed represent the low limit. A maximum feed of $\frac{1}{32}$ in. is recommended for all steel cutting with cemented carbide tools. For cast iron, malleable iron, aluminum, brass, bronze and copper, the $\frac{3}{32}$-in. maximum feed may be used under the proper conditions. No figures are given for the machining of either monel bar stock or cast monel metal with Stellite J, Stellite 2400, or cemented carbide tipped tools. Experience to date has shown that these materials can be machined best with high-speed steel tools.

The kind of cutting tool used has a direct bearing on the cutting speed. However, all of the tools listed are very efficient on some work at different cutting speeds. The cutting speeds are given for five different grades of cutting tools. The high-speed steel is the regular 18–4–1 grade. The super-high-speed steels are the cobalt steels. Stellite J is a non-machining cast alloy of cobalt, chromium and tungsten. Stellite 2400 is composed of the same elements, but in different proportions. The cemented carbide tools listed are either tungsten carbide, tantalum carbide, or titanium carbide.

Tantalum and titanium are added to tungsten carbide tools to act as a lubricant for steel chips so that the steel will not tend to crater out and pick up small pieces of tungsten. Although these grades are called tantalum and titanium carbides, the cutting material is still tungsten and the tantalum and titanium act merely as a lubricant to reduce the friction between the chips and the tools. Incidentally, there also are several relatively new grades of high-speed steel which are giving results comparing very favorably to those obtained from cemented carbide tools. Some of these carry a very high percentage of tungsten and cobalt, and a low percentage of molybdenum and vanadium.

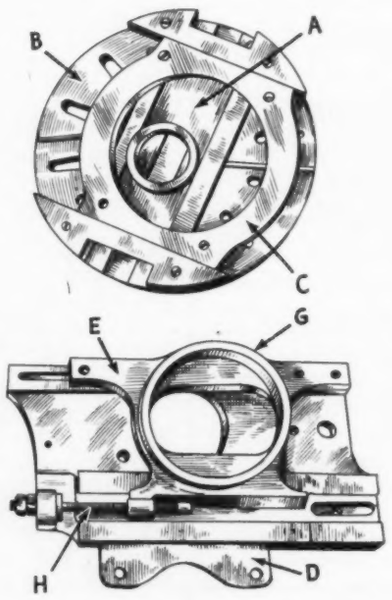
It will be noted that in Table II two cutting speeds are given for each material and each tool. For example, when machining SAE X1112 with high-speed tools and lubricant, the recommended cutting speeds are 44 to 161 surface ft. per min. These are the low and high limits and are dependent on the design of the work piece, the depth of cut, and the feed per revolution. A cutting speed about half way between these two figures should be used when starting the average job. If it is found that the cutting tools will not last for a sufficient length of time, the cutting speed will have to be reduced slightly. On the other hand, if the cutting tools stand up well, a slightly higher cutting speed should be tried. Always run as fast as the tools and the design of the work will permit, since a better surface finish will be obtained. The values given in the table are not hard and fast. In every case, where a new job is run, the operator should try various combinations of speeds and feeds until one is reached which gives the best finish with a reasonable life.

A 50-Year Old Oval Chuck

BY FRED H. COLVIN

CHUCKS FOR TURNING OVALS, sometimes called "wabble" chucks, are not new. The illustration was made from a photograph taken by the writer 50 years ago in a small Philadelphia shop. Such chucks are not used often, but occasional inquiry indicates that some still want them, and two firms are listed as making them. The chuck shown was made to turn punches and bore dies for making the tops and bottoms of oval dinner pails, which was the accepted shape at the time. The cover contained a space for coffee which was heated by setting the cover on any warm object in the shop and, unless the cork was loosened, it sometimes blew out with a noise like a fire-cracker.

Just in case anyone wants to build one the construction can be easily explained. The slide *A* screws on the spindle nose and is held in guides on the back of faceplate *B*. The back of the faceplate also carried another slide *C*, at right angles to *A*. This slide has a large circular opening in the center.



The other part of the chuck consists of the base *D* which bolts against the face of the headstock so that the spindle nose comes through the opening shown. The sliding member *E* has a projecting ring *G* which fits inside the opening in *C* and controls the movement of the face plate *B*. The position of slide *E* is regulated by the screw *H*.

With the ring *G* in the center, concentric with the lathe spindle, work bolted to the faceplate will be turned or bored round. Moving ring *G* off center causes slide *C* to move the faceplate along slide *A* twice during each revolution. This combined movement causes the work on the faceplate to move so that a single-point tool will generate an oval. The amount of oval, or difference between the minor and major diameters, depends on the distance the ring *G* is moved.

Oval boring and turning can also be produced by a cam-controlled cross-slide movement. By either method it is necessary to be sure that the cutting edge of the tool has clearance at all points of the revolution, and is set at the center of the spindle. In practice these oval chucks are quite satisfactory.

Factory fire fighters

BY LEONARD F. MAAR, SAFETY RESEARCH INSTITUTE

MACHINE SHOPS include such a variety of equipment and processes that it is impossible to do more than generalize about fire protection unless the hazards of each situation are considered separately. One important new development in plant fire protection, however, concerns organization of the company fire brigade.

Such a brigade customarily is a central unit. Its members are either on full-time fire duty, or are drawn from their jobs in a fire emergency. Their training and drills lead them to think of the plant as a whole, with fire alarm boxes and equipment stations located according to the hazards involved. When an alarm sounds, they drop their work and rush to the source of the trouble, bringing whatever equipment is called for by the scheme of things.

The weakness of this system is the inevitable delay between the time when the trained employee hears the alarm signal and the time he reaches the fire. In those few moments, a small fire might easily get beyond control of first aid equipment and open up sprinkler heads or require quantities of water with consequent damage.

There is a growing tendency, fostered by fire protection engineers, to alter the make-up of the plant fire brigade so that in each department there are men on the spot to combat fire as soon as it occurs. The effect of this system is to reduce the losses from fire and also to reduce the number of fires. The plants of Chrysler Corporation, in the first three years under the departmental system, reduced its fire losses 60 per cent, according to the inspection department of the Association Factory Mutual Fire Insurance Companies.

Fire will break out. In 1938, the last year for which figures are available, the National Fire Protection Association estimated there were 900 fires in metal-working shops alone with losses exceeding $630,000. Indications are that with production increased in many lines this year, the total will be far greater than that, for such is the history of the fire menace. As new employees are added to payrolls, and as new shifts of workmen and shop executives take over their duties, the essentials of fire protection are easily lost sight of in the haste and confusion of readjustment. That is exactly the time when the defenses against fire must be tightened for then the consequences of fire can be greater, destroying more property and more jobs. The national fire loss in January of this year was 31 per cent greater than for the same month in 1939. February showed an increase of more than seventeen per cent.

The hazards of metal-working shops are well known. According to

the N.F.P.A., the fire record in machine shops is as follows:

Heat-treating processes ten per cent
Oil burners eight per cent
Cutting and welding eight per cent
Spontaneous ignition seven per cent
Sparks and friction six per cent
Hot materials or heat igniting combustibles six per cent
Miscellaneous special hazards twenty-five per cent
Electrical causes fifteen per cent
Miscellaneous common causes fifteen per cent

In the building of departmental fire brigades, there are three objectives: prevention, protection, and minimum fire and water losses. The foreman or his assistant may act as captain. He will select as brigade members able-bodied men who are most likely to be constantly on their jobs.

Since brigade members have the fire hazards under their supervision day in and day out, they are more likely to control them carefully as they gain in understanding of the fire potential of each hazard. This makes for increased efficiency in fire prevention.

They should be instructed in the use of fire extinguishers and know what types to use on the various classes of fire. In fact, the fire extinguisher is the first line of defense against fire. Under the departmental system the fire extinguisher detail of the brigade will snuff out most of the fires before they get started.

One group of men should be instructed in laying fire hose so when fires are of greater magnitude than the extinguishers can handle, they will be ready to go into action with streams of water. Another group will act as a salvage corps, covering machinery and materials with tarpaulins to protect them from possible water damage.

The brigade captain generally is charged with responsibility for judging whether or not a fire emergency is severe enough to sound a general plant alarm or to summon the public fire department. He also will deputize one or two men to shut off electric power and motors. The coordination of the departmental brigade with the entire plant fire protection system will depend in a large measure upon the physical characteristics of the property and the hazards involved.

The plant fire chief will respond to every alarm. When he arrives at the scene of a fire, he assumes full command of the fire fighters.

The maintenance of equipment is of first importance in any scheme of fire protection. Fire extinguishers, which have generally supplanted the use of pails of water and sand, should be located at positions that are plainly marked and visible. No obstructions should prevent easy access to them. They should be inspected frequently to make certain they are filled and ready for use, and at least once each year they should be more fully inspected and recharged as directed by the manufacturer. Recharging supplies and replacement parts should be obtained from the manufacturer as the use of sub-standard chemicals or ill-fitting parts may greatly impair the efficiency of the extinguishing unit.

The organization of departmental brigades may take more time and effort than the central brigade system, but it also will be a valuable investment in fire safety.

Blanking and piercing operations

BY J. T. WEINZIERL AND A. C. HEINTZ, ALUMINUM COMPANY OF AMERICA

Cutting of sheet aluminum with press tools is not difficult when a few simple rules are followed. Sharp cutting edges, proper clearances and ample lubrication of work are needed

IN BLANKING ALUMINUM, as in blanking other metals, the tools consist of a punch and a die, the punch being the moving member attached to the ram of the press and the die being stationary on the bed of the press. The material to be blanked is usually in the form of coils or flat sheet which is fed over the top of the die by hand or mechanically. The necessary guides may be attached to the bed by the press or may be part of the tool.

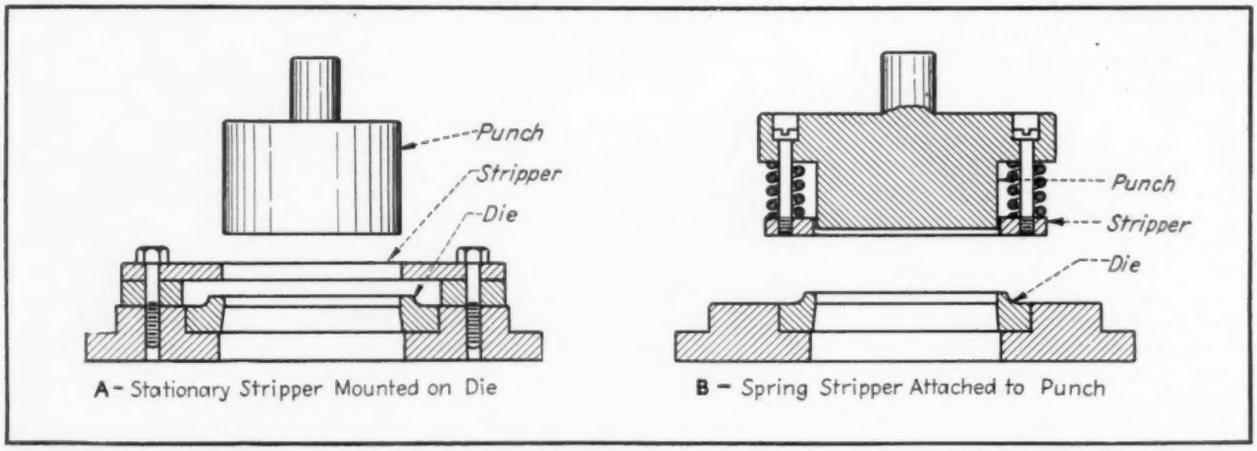
During the operation of blanking, the material being blanked is pinched between the outer edge of the punch and the inner edge of the die. While the blank is pushed into the die and the punch is pressed into the material, a true cutting action takes place and continues for about one-third of the thickness of the material being blanked. The cutting action is followed by fracturing the material for the remaining two-thirds of the thickness. Examination of the edges of the blank will show a bright band indicating the depth of actual cutting, and a wider band showing the fracture.

There are a number of different methods for stripping the scrap from the punch. The two most commonly used are: (1) a stationary stripper, rigidly attached to the die, as shown at *A* in the accompanying sketch; and (2) a spring stripper attached to the punch member, as shown at *B*.

In blanking aluminum, the punch usually is made of annealed tool steel, while the die almost always is made of hardened tool steel. The faces of the punch and die should be ground to insure keen cutting edges. In cases where it is necessary to reduce the load on the press, it is recommended that the top of the die be ground so that the cutting edge is not on one plane around the die opening. One method is to have two opposite points

Table III—PUNCH AND DIE CLEARANCES FOR BLANKING
(t = thickness of sheet in inches)

Aluminum sheet alloy	Clearance		Aluminum sheet alloy	Clearance	
	On a side	On the diameter		On a side	On the diameter
2S–O	0.10t	0.20t	24S–O	0.13t	0.26t
2S–½H	0.12t	0.24t	24S–T	0.16t	0.32t
2S–H	0.14t	0.28t			
			52S–O	0.13t	0.26t
3S–O	0.10t	0.20t	52S–½H	0.14t	0.28t
3S–½H	0.12t	0.24t	52S–H	0.15t	0.30t
3S–H	0.14t	0.28t			
			61S–O	0.11t	0.22t
17S–O	0.13t	0.26t	61S–W	0.12t	0.24t
17S–T	0.16t	0.32t	61S–T	0.14t	0.28t



The two methods commonly used for stripping scrap from the punch are the stationary stripper, shown at A, *which is mounted on the die or die shoe, and the spring stripper* B, *attached to the punch*

These circular aluminum blanks were produced from strip stock in a No. 675 Bliss double-crank, single-action press having straightening and feed rolls at the right. When cut from the strip, the blanks drop through the die into a chute in the bed of the press

that are high, with low points between them. This is readily accomplished by tilting the die on opposite angles when grinding the top of the die. The difference between the height of the high and low points should be at least one-half of the thickness, but preferably the full thickness, of the material to be blanked. It should be understood when cutting out blanks which must be flat, that the punch should be ground flat and the die may have high and low points. When punching holes in material that must be kept flat, the die should be ground flat and the punch may have high and low points.

Many blanking tools in use have no means of aligning the punch and the die. This puts a great responsibility on the die setter, and there is always a chance of shearing or scoring the punch. Mounting the punch and die in a leader pin die set is recommended since the time needed to set up the tool is shortened considerably and the cost of tool maintenance is reduced.

Table III shows the clearance between the punch and die for blanking various aluminum alloys and tempers. When these clearances are used, the power needed both to operate the tool and to do the stripping of the scrap will be at a minimum. The clearances used in actual practice are about one-half those given in the table to allow for wear that occurs, especially on the punch diameter.

Table IV shows the recommended scrap on the sides and between blanks for various gauges and diameters. Standard mill tolerances on widths for coils and flat sheet were taken into consideration when calculating the scrap allowances given in this table.

Both Sheet and Tools Oiled

Lubrication is essential in keeping tool maintenance costs low. A medium grade of engine oil plus a small percentage of fatty oil diluted with kerosene has been found to give the best results when hard aluminum sheet is being blanked. When the sheet is of a softer alloy or temper, the engine oil and fatty oil mixture is used without dilution. It is desirable to lubricate both the sheet to be blanked and the cutting edges of the tool. By pulling the sheet being blanked between felt pads saturated with the lubricant, a thin film of lubricant will be applied to the surface of the sheet. The felt pads are usually attached directly to the die or on the bed of the press so that the lubricating will be done just before the metal reaches the die. A ring of felt placed around the punch above the stationary or spring stripper may be used for more direct lubrication of the punch. The felt is saturated with lubricant which trickles down to the edge of the punch.

When blanking bright-finished aluminum sheet where it is necessary to

Table IV—SCRAP ALLOWANCES FOR BLANKING

Gage	*Blank Diameter (Dimensions in Inches)*	*Scrap On the Side (In.)*	*Scrap Between Blanks (In.)*
No. 28 Ga. (0.013 in.)	0 to 10 incl.	1/8	1/16
to	10 to 20 incl.	3/16	3/32
No. 15 Ga. (0.057 in.) incl.	20 to 30 and over	1/4	1/8
No. 15 Ga. (0.057 in.)	0 to 10 incl.	5/32	3/32
to	10 to 20 incl.	7/32	1/8
No. 12 Ga. (0.081 in.) incl.	20 to 30 and over	5/16	5/32
No. 12 Ga. (0.081 in.)	0 to 10 incl.	3/16	1/8
to	10 to 20 incl.	1/4	5/32
No. 8 Ga. (0.128 in.) incl.	20 to 30 and over	3/8	3/16

Annealed circular blanks of a common aluminum alloy here are being removed from the conveyor of a continuous furnace

maintain the bright finish, it is recommended that the punch and die face be covered entirely with cloth except at the cutting edges. The stripper usually is covered with cloth to avoid scratches while the metal is being stripped from the punch. A common method of holding the cloth on the various parts of the tool is to use shellac as an adhesive.

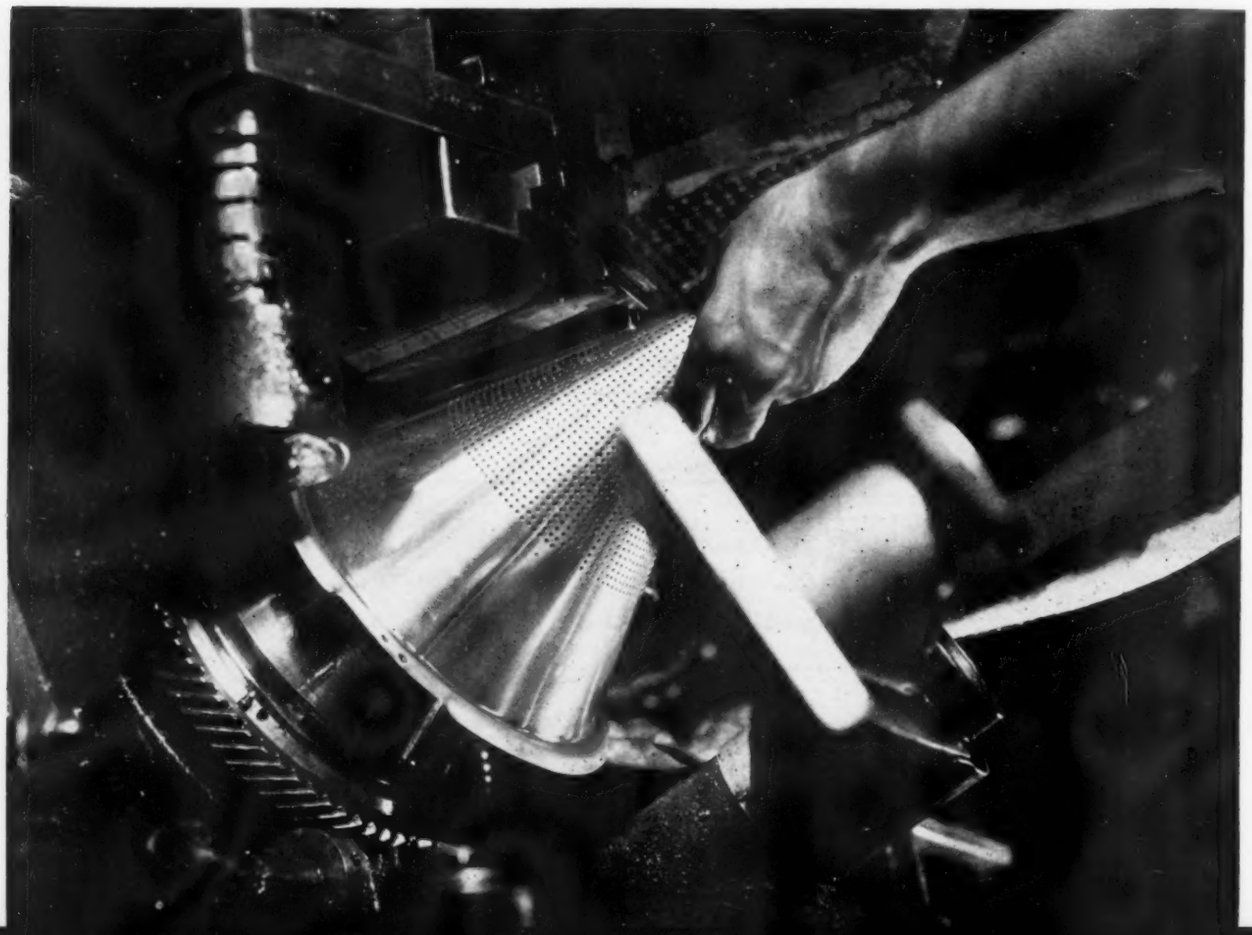
Piercing is fundamentally the same as blanking, and consists of cutting small holes, such as rivet holes, by means of press tools. The term "blanking" is used if the holes are large, or if the part cut out of the hole is the usable portion and the remaining metal, the skeleton scrap. Perforating is the piercing of many closely spaced holes.

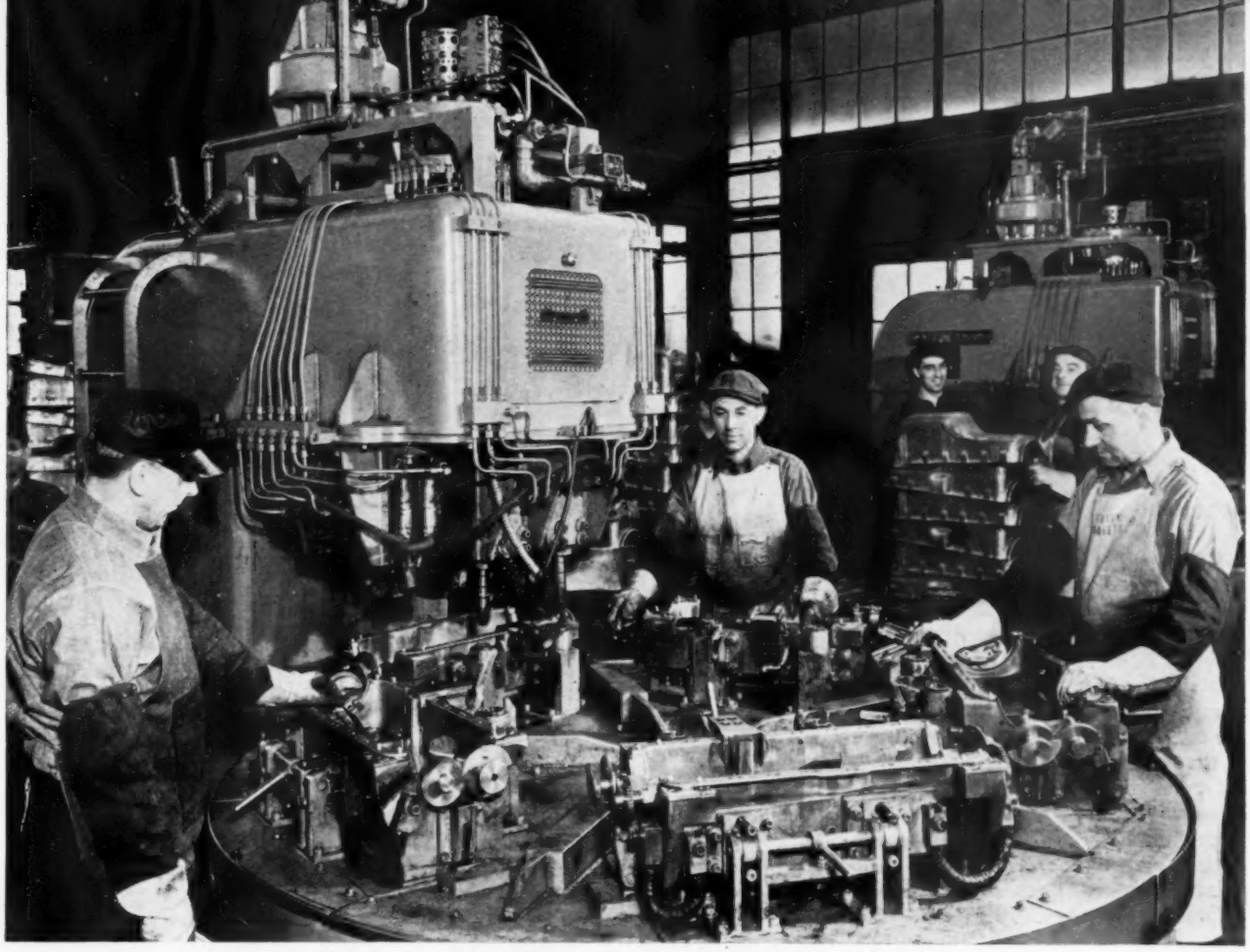
A difficulty commonly experienced when piercing or perforating aluminum is the lifting of the slugs when the punch is moved out of the die on the return stroke of the press. To avoid this difficulty, the clearance between punch and die should be not more than five per cent of the metal thickness.

Piercing and perforating commonly are done in single-action presses. In making holes in the side walls of hollow ware, however, a horn press is used.

The third article in this series on the cold working of sheet aluminum will appear in an early issue.

This cone was perforated in sixteen strokes of a horn press. The geared fixture shown is indexed automatically after each group of holes has been pierced by multiple punches on the ram

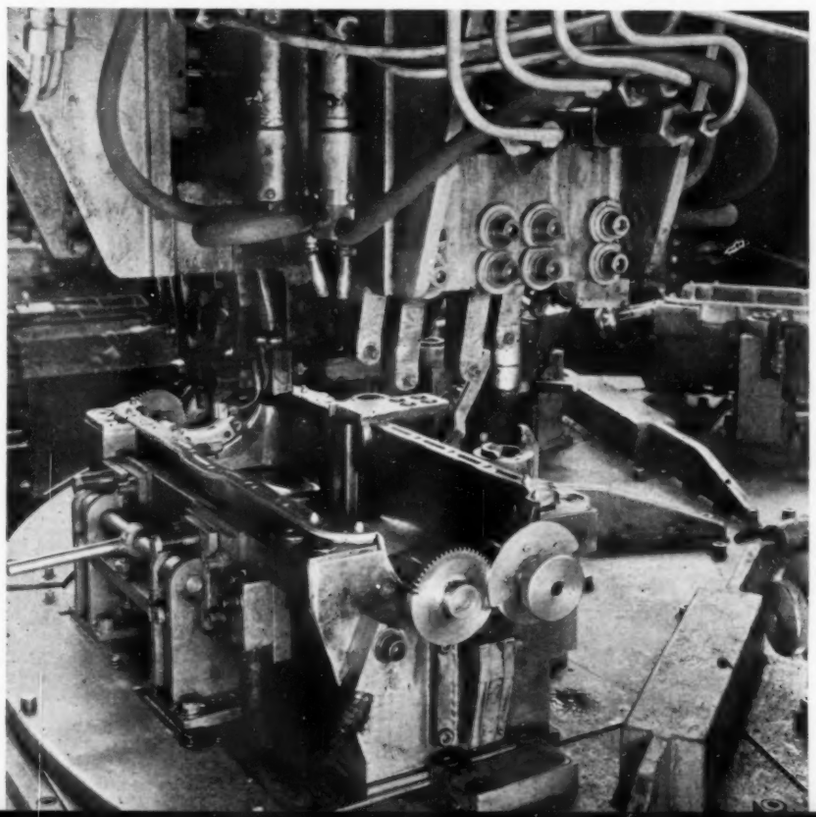




Dodge welds thin sections to thick with these fixtures

Table-top welding

Toggle-operated electrodes reaching down into the oil pan make for short current travel, reduce electrode maintenance, and permit the desirable welding condition of passing current from the thinner to the thicker piece



LONG LEADS to welding electrodes are avoided in the hydromatic type welder installed at Dodge Division of Chrysler Corporation for spot welding various sheet-metal parts to oil pans. Electrodes operated by toggles move down into the fixture and weld from the thinner sheet metal pieces to the thicker oil pan. Design of the toggle mechanisms constituted a different problem because of space limitations, but better welding results when it is possible to spot weld from a thin to a thick section.

Five fixtures are spaced around a geneva-indexed table. Operators first lay thick reinforcing pieces over two dowel pins at each corner, after which the oil pan is dropped into place. Next two baffle plates are slid into the bottom of the oil pan. Holes in the baffle plates snap over dimples in the pan, no other locating means being required. A channel section that serves as a protector for the oil-dip rod is located at one side of the pan by a conventional quick-acting pad. Sealer rings at each end of the oil pan are located by a novel gear clamp. Formerly, two individually operated clamps were provided, but the operators desired a single clamp. So the shafts for the two clamps were geared together, and the operator is now required to turn only one knob.

Gear tooth contact

BY C. A. YOUNG

The author clears up some of the confusion surrounding the definition and derivation of the arcs of approach and recession

CONSIDERING two teeth coming into mesh, one tooth first makes contact with the other at the tip of the tooth. That is, the point of contact is the intersection of the outside circle of the one tooth with the involute curve of the other tooth. This point is also the point of intersection of the line of action, since all tooth contact takes place on the line of action. From this initial point, as the gears rotate, the point of contact moves down one involute and up the other, always remaining on the line of action, until it leaves contact at the tip of the other tooth.

This action may be shown graphically. In Fig. 1:

R and R_1 = Pitch radii of gears O and O_1 respectively
R_b and R_{b1} = Radii of the base circles
R_o and R_{o1} = Outside radii
OO_1 = Centers
ϕ = Pressure angle

The line of action is the straight line ABC drawn tangent to the two base circles. The first point of contact is the intersection of the outside circle of gear O with the line of action. That is, point D. Tooth contact proceeds, from rotation of the gears, along line ABD to point E, the last point of contact, which is the point of intersection of the outside circle of gear O_1 with the line of action. The teeth have, therefore, been in contact from point D to point E, along straight line DBE. The line DBE is the duration of contact.

A model will help to make this clear. Cover a board with paper, and on it draw the pitch circles and outside circles of a pair of mating gears. Cut the two base circles of some material at least $\frac{1}{8}$ in. thick and nail them on their respective centers. Now fasten a string on base circle O, Fig. 2, at some point as X, wrap it around counterclockwise to A and jump over to base circle O_1 along line AC. Tie a knot at point B where the string crosses the common centerline and wrap the string around base circle O_1, fastening it at some point Y.

Rotate base circle O_1 clockwise and the knot at B will move to C. Now, keeping the string taut by slightly braking base circle O_1, rotate base circle O clockwise, moving the knot to point D, where it touches the outside circle of O. This is the first point of contact. Further rotation in the same direction will move the knot through point B to point E, where it touches the outside circle of O_1. This is the last point of contact. The knot at all times represents the point of contact of the two involutes of the meshing teeth, and is always on the line of action ABC. The teeth will not touch at any other point or leave the line of action unless there is interference.

For purposes of computation and study the duration of contact (line DBE) has been divided into two parts, DB and BE. Point B is the point of tangency of the two pitch circles. It is also the point of intersection of the line of action and the common centerline. Therefore, the arc of approach is the duration of contact from initial contact to contact at the pitch line, and the arc of recession is the duration of contact from contact at the pitch line to final contact. Thus for gear O, line EB is the arc of approach if the gear is rotating counterclockwise, and line BD the arc of recession. For gear O_1 rotating counterclockwise, line DB is the arc of approach and line BE the arc of recession. Obviously the sum of the two arcs is the total duration of contact (line ED or DE).

Now let us see how this word "arc" crept into the picture when we were considering *straight* lines. Moving the knot from D to B made a definite unwinding of string from base circle O_1 and a definite winding of string on base circle O. Before unwinding, the length of string required for this movement was a length of arc on circle O_1 and involved a corresponding winding of a straight line into an arc on circle O. Thus AC or any portion thereof may be expressed as a length of arc on either base circle O or O_1. So, in Fig. 1, if we are considering the arc of approach of a tooth on O_1 we can express line DB in terms of length of arc to radius R_{b1}, and the arc of recession of a tooth on O_1 as line BE in terms of length of arc to radius R_{b1}. For gear O, the arc of approach would be an arc of length EB to radius R_b and the arc of recession an arc of length BD to radius R_b.

For definitions, then, the arc of approach is the length of arc on the base circle through which a tooth travels from the time it first touches its mating tooth until the two teeth touch at their pitch circles; and the arc of recession is the length of arc on the base circle through which a tooth travels from the time the two teeth touch at their pitch circles until a tooth last touches its mating tooth.

These two arcs may be found mathematically in three different ways:

1. Let θ = angle AOD and θ_1 = angle CO_1E

$$\cos \theta_1 = \frac{R_{b1}}{R_{o1}} \quad (1)$$

$CE = R_{o1} \sin \theta_1$
$CB = R_1 \sin \phi$ or $R_{b1} \tan \phi$
$BE = CE - CB$

Arc of approach of gear O
= arc of recession of gear O_1
$= R_{o1} \sin \theta_1 - R_1 \sin \phi \quad (2)$
$= R_{o1} \sin \theta_1 - R_{b1} \tan \phi \quad (3)$

$$\cos \theta = \frac{R_b}{R_o} \quad (4)$$

$AD = R_o \sin \theta$
$AB = R \sin \phi$ or $R_b \tan \phi$
$BD = AD - AB$

Arc of approach of gear O_1
= arc of recession of gear O
$= R_o \sin \theta - R \sin \phi \quad (5)$
$= R_o \sin \theta - R_b \tan \phi \quad (6)$

2. By squares of the sides of the triangles:

$$CE = \sqrt{R^2_{o1} - R^2_{b1}}$$
$$CB = \sqrt{R^2_1 - R^2_{b1}}$$
$$BE = \sqrt{R^2_{o1} - R^2_{b1}} - \sqrt{R^2_1 - R^2_{b1}} \quad (7)$$
$$AD = \sqrt{R^2_o - R^2_b}$$
$$AB = \sqrt{R^2 - R^2_b}$$
$$BD = \sqrt{R^2_o - R^2_b} - \sqrt{R^2 - R^2_b} \quad (8)$$

3. Also, since θ and θ_1 must be found in either method above, the arcs may be figured thus:

Let β and β_1 = Angles BOD and BO_1E respectively
$\beta = \theta - \phi$ and $\beta_1 = \theta_1 - \phi$

Two sides and the included angle of triangles BOD and BO_1E are known and therefore sides BD and

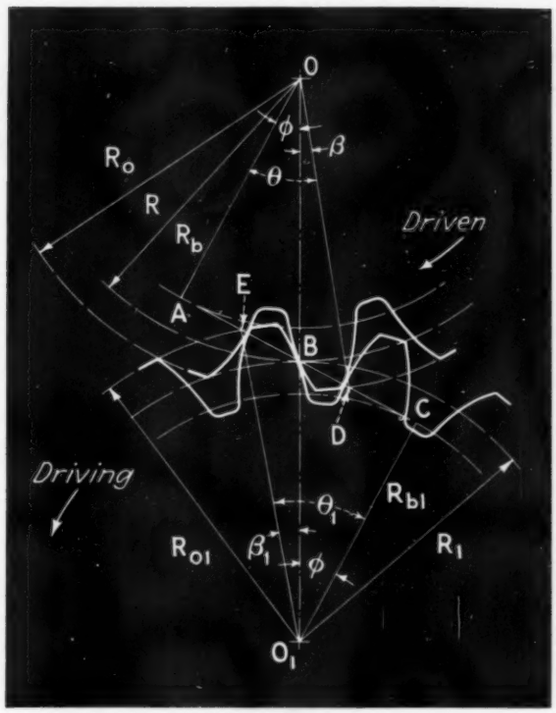


Fig. 1

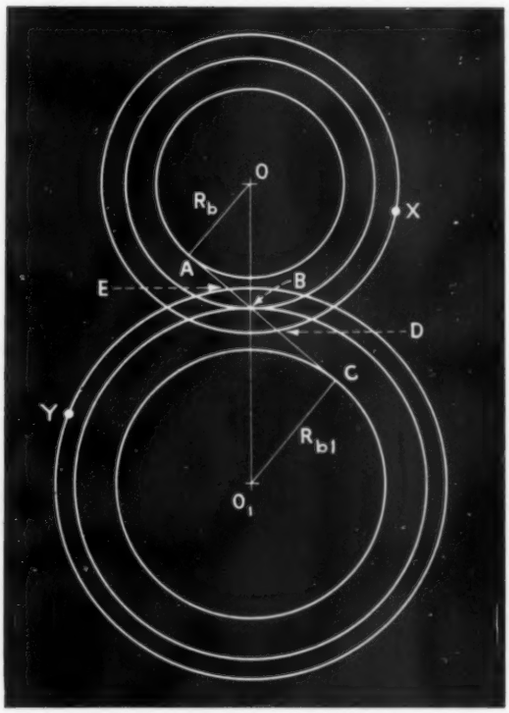


Fig. 2

BE may be determined by solution of these oblique triangles:

$$BE = \sqrt{R^2_{o1} + R^2_1 - 2R_{o1}R_1 \cos \beta_1} \quad (9)$$

$$BD = \sqrt{R^2_o + R^2 - 2R_oR \cos \beta} \quad (10)$$

In circular measure (radians) the angle of approach, that is, the central angle of the gear through which the gear rotates while passing through the arc of approach, is the quotient of the arc of approach for that gear divided by the radius of its base circle, and the angle of recession is the quotient of the arc of recession for that gear divided by the radius of its base circle.

Duration of contact DE = Arc of approach DB + arc of recession BE (11)

The number of teeth in contact at any instant follows directly from the above, since we know that any tooth is in contact with its mating tooth for a distance *DE*. The number of teeth in contact at one time is, therefore, the number of teeth included in this distance. Thus the number of teeth in contact is the quotient of the duration of contact divided by the circular pitch, since there is one tooth in one circular pitch. This ratio is called the contact ratio.

$$\text{Contact ratio} = \text{Number of teeth in contact} = \frac{\text{Duration of contact}}{\text{Circular pitch}} \quad (12)$$

It might be well to bring up one other point relating to this study. That is tip relief and what to do with it in the formulas above. Since tip relief is a true relief, any part of the tooth in the relieved portion does not contact the mating tooth. Therefore the initial and final points of contact will be at the end of the involute (the beginning of the relief) and will be at the point of intersection of this point with the line of action. In other words, reduce the outside diameter by twice the depth of relief and use this diameter in the same way as the true outside diameter was used in the above. Thus, if the gear was 20 in. O.D. and had 0.125 in. tip relief, use 19.750 in. as the outside diameter.

Machine Tool Designations

THE National Machine Tool Builders Association can make the selection and ordering of machines much easier for purchasing agents and others by a little get together on standardization. It has already done a good job on spindle noses for lathes and milling machines, T-slots and toolpost openings. But both names and machine designations leave much to be desired.

Arbitrary numbering of machines, instead of designation by capacity, causes much misunderstanding and delay. Milling machine numbers are the exception but even here, designation by capacity would greatly simplify comparison when ordering.

Engine lathes are satisfactorily designated as to swing, as even the "extra capacity" beyond designated dimensions, is not particularly misleading or harmful. Capacity between centers however is more important than length of bed. But when it comes to turret lathes, we have a variety of makes with arbitrary numbers that do not tell the capacity of the machines. They should give both bar stock and chucking capacity.

Planers and shapers are designated by their work capacity but the tool room slotter or vertical shaper and the jig borer usually have numbers that give no clue to the size of work they are designed to accommodate.

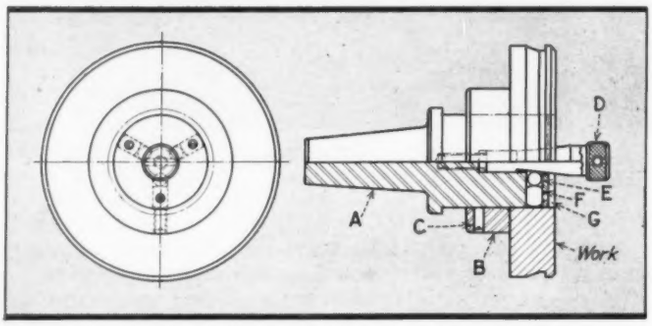
Cylindrical grinding machines and some surface grinders are rated by the size of work that can be done on them. But internal grinders, small boring machines, and even large table and floor type horizontal boring machines are given numbers that are Greek to all but the manufacturers. Cooperation of machine tool builders through the N.M.T.B.A. can work out methods of designating the capacity of different machines that will be of value to buyers generally. This will save the buyer the necessity of looking up different catalogs to compare capacities of various machines.

IDEAS FROM PRACTICAL MEN

Quick-Acting Chuck for Thin Rings

By J. B. BOOTH
Bradford, England

The illustration shows a quick-acting chuck for facing and turning thin bored rings. It consists of the steel body *A* fitted with a tapered shank to suit the spindle nose and a parallel portion which is two and one half times longer than the thickest ring likely to be held and is of such diameter that the ring slides on



This chuck was made for facing and turning large quantities of accurately bored rings. A tapered center plug forces plungers radially against the bored diameter of the work

with a snug fit. A small shoulder is machined at the junction of the parallel and tapered portions of the body.

A collar *B* is bored to a snug fit on the parallel part of the body *A*. The right-hand face of the collar should be square with the bore since it is the locating face against which the work is held prior to clamping. The screw *C* secures the collar *B* to the body *A*. The latter is drilled centrally to take the tapered plug *D*, which is threaded and screws in the hole in *A*. A short parallel section on the plug fits the hole in *A* to prevent the plug from locating itself entirely from the threaded end. The head of the plug is enlarged, knurled and cross drilled to facilitate turning.

The middle section of the plug *D* is tapered approximately 12½ deg. inclusive, and engages with the steel balls *E* located in three radial holes in the body. Plungers *F* bear on the balls *E* and against the bore of the ring to be machined; the plungers are prevented from passing out of the body holes by setscrews *G* which engage small flats or grooves milled on the sides of the plungers. When setscrews *G* are adjusted, plungers *F* should be free to slide in the holes.

In using the chuck, it is trued up on the spindle and the collar *B* is adjusted along the body and clamped so as to permit the right-hand face of the ring to overhang slightly the end of body *A*. After a ring has been placed on the chuck it is held tightly by plungers *F* when the plug *D* is tightened in the body.

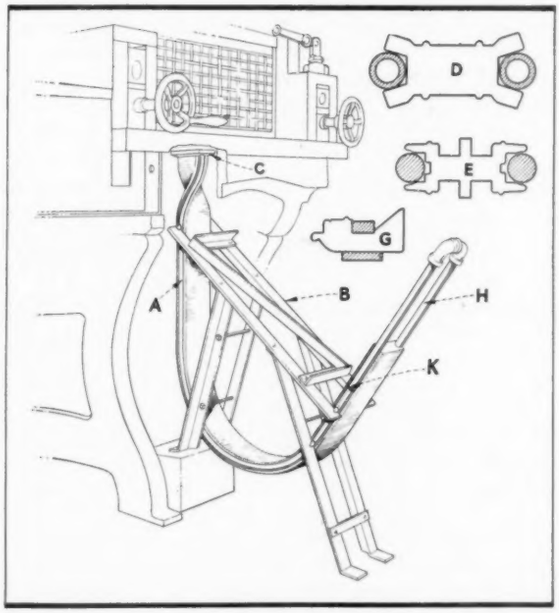
After facing one end and the periphery of the ring, the collar *B* can be withdrawn to take a light cut on the other face, thus completing all operations at one setting of the chuck.

Automatic Blank Stacker Speeds Production

By JOHN E. HOAGLAND

A good stacking device for a blanking press should keep the blanks flat, eliminate abuse of the blanks when they are placed in a tray, and permit unloading while the press is running, especially when an automatic feed is used. The illustrated stacker accomplishes all of these.

It consists of guide rails *A* so spaced to permit the blanks to slide freely; the frame *B* which supports the guide rails; and the plate *C* which is made ½ in. larger than the blank, and fits into the clearance hole of the bolster plate where it is fastened with filister head screws. The guide rails are made of bent pipe or cold-rolled stock, and positioned to suit the shape of the blanks; three types of rails and blanks are shown at *D*, *E* and *G*. The guide rails are welded to the frame.



This stacking device for a blanking press fits into the clearance hole in the bolster and guides the blanks onto a holder which can be removed and preplaced without stopping the machine

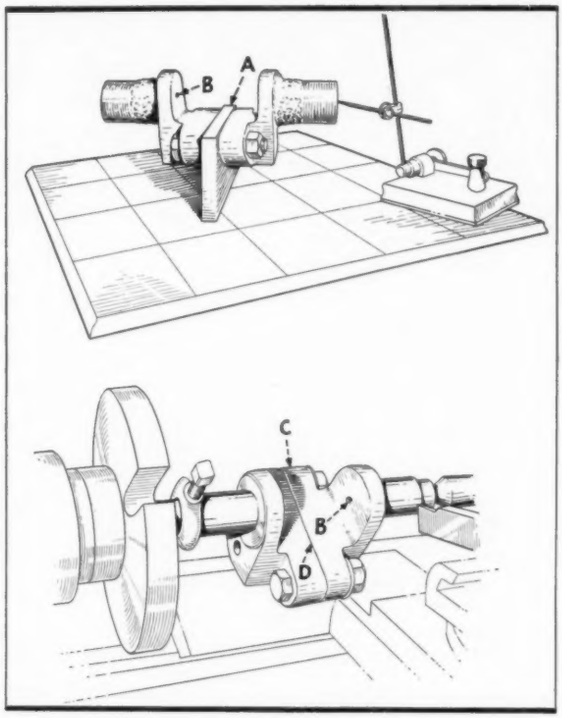
The neck of the illustrated stacker adjacent to the bolster is twisted 90 deg. Other stackers in use at our plant are not twisted, the desirability of using the twist depending on which way is the easiest to deliver the blanks from the die to the curved part of the stacker. This is relative to the shape of the blank.

As the blanks come out of the die, they are guided by plate *C* onto the rails *A* and finally fill up the holder *H*; the latter is a separate piece of the rails and when filled can be detached at joint *K*. The operator grabs the blanks just below joint *K*, removes the holder, places it in a tray, and inserts a spare holder.

Proper Repairs for Locomotive Links

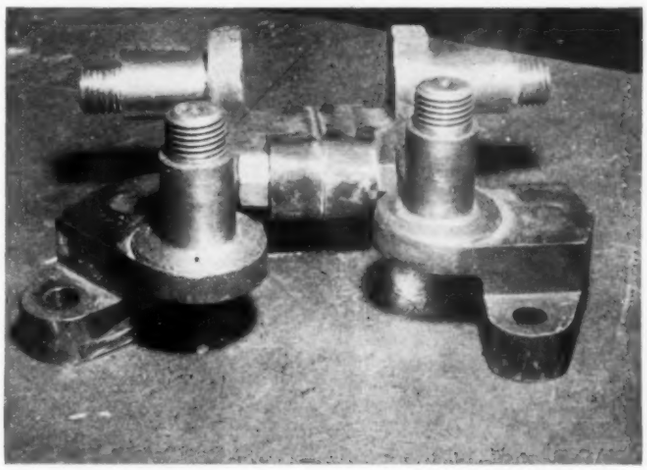
By ARTHUR HAVENS

For many years the repair of link bridges on Stevenson valve-gear double hanging links has been a haphazard affair. Usually the worn pins are rebuilt by welding and machined round, completely disregarding the face of the bridge that bolts to the link. To install links so repaired requires heating and twisting the link hangers until they slip on the bridges. Links so hung will never swing freely and the engineman must exert much effort to reverse the gear.



Worn link-bridge pins of Stevenson valve gear should be removed, new pins scarfed and welded in place, and centered accurately with the center of the bridge. The centers are located with the bridges bolted to a plane plate. This is removed and the bridges bolted back to back for turning and threading the pins

The following repair method eliminates this trouble. Flame cut the pin from the bridge, leaving a 1-in. stub in the center of which is drilled a $\frac{3}{16}$-in. hole $\frac{1}{2}$ in. deep. Drill a similar hole in one end of a piece of soft steel turned $2\frac{1}{2}$ in. in diameter and 3 in. long. Scarf the stub and the drilled end of the new pin, insert a piece of $\frac{3}{16}$-in. welding rod in the stub, mount the new pin on the extending portion of the $\frac{3}{16}$-in. rod, and weld the assembly. Repeat this for each of the three remaining bridges in the link set. Most of the warping can be overcome by welding on alternate sides of the Veed stub and pin.



Stevenson link-bridge pins machined concentric with the bridge simplify repairs to the valve gear

Usually the face of the bridge that bolts to the link will not be square with the pin. To correct this, the back of the bridge is rebuilt by welding and later machined square with the pin, and to the correct thickness from the link face to the bottom on the pin, using a shaper. Care in this operation determines the success of the entire repair method. If the pins are too long, they can now be cut to length in the shaper.

The bridges are then bolted to plane plate *A*, as shown in the illustration, in the same position as when bolted to the link. A surface gage is used to determine the height of the center hole *B* in each bridge; the surface gage is then set to the average height of these center holes, and a horizontal line is scribed on the end of each pin. The vertical line is found by dividing the length of the plate in half and scribing this distance on the end of the pin wherever it may come. The intersection of the two lines will be the centers upon which the assembly will be turned.

The bridges are removed from plate *A* and bolted together as at *C* for mounting on lathe centers. A sharpened $\frac{1}{8}$-in. drill rod is fastened in the toolpost in such a position that the point touches the seam *D* where the bridges join. The assembly is turned by hand and the pointer manipulated in and out with the movement of the work. If the pin centers are correct, the pointer will follow the seam the entire distance; if not, the centers are changed the amount needed to correct the error. Finally, the pins are turned to diam-

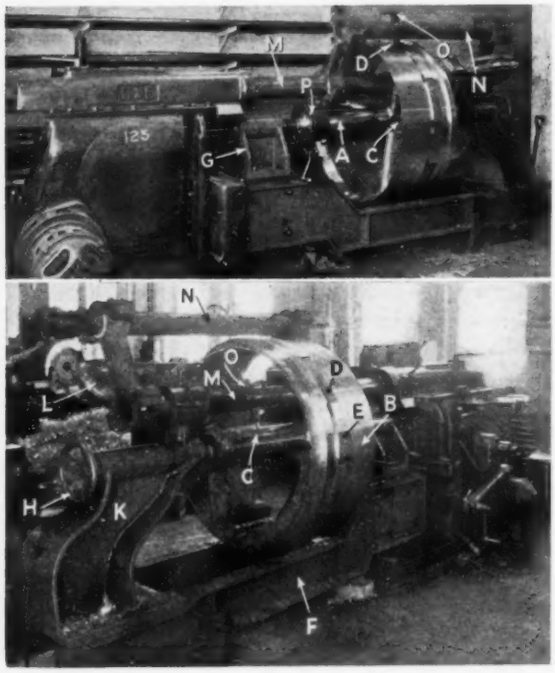
eter and threaded, and the cotter pin holes drilled.

The link hangers are usually in bad shape and to make the job complete they should be checked for length, straightened, and all errors corrected before they are assembled to the links. Stevenson links repaired in this manner are easy to assemble, and repairs to link motion at later shoppings of the locomotives are simplified in that it is only necessary to replace link-hanger bushings and grind links and link blocks.

Large Spider Castings Finished on Shaper

By H. E. LONG, ASSISTANT WORKS MANAGER
Steacy-Schmidt Manufacturing Company

We had to machine eleven bronze riser valve units for the water-supply system of New York City. The central stem *A* and the body *B* of the spider castings were first turned to size on a boring mill, leaving portions *C* of the stem between the radial arms and surfaces *D* between lugs *E* on the outside body unfinished. These had to be finished on a machine that



The necessary reciprocating cut and circular feed for finishing the stem and outside lugs of this water-valve spider casting was obtained with this fixture mounted on a Gould & Eberhardt shaper

had a reciprocating motion for the cutting tool and a circular motion for the feed. The illustrated fixture furnished both these motions.

It consists of the cast-iron side arms *F* and the fixed center *G* bolted to the shaper table; the live center *H* and supporting bracket *K* which is offset for clearance of spider arm *L* as the spider revolves in the fixture; the shaper ram extension *M*; and the over-arm *N* bolted to the ram extension *M*. Both arms *M* and *N* were slotted for snug fits of toolholders *O*, each of which pivots about a central pin; the toolholders were drilled with holes 1 in. apart to obtain major vertical adjustment of the tool. Small vertical adjustments were made with the toolbits. Tool drag on the return stroke of the shaper was obtained by installing a spring between a stop pin and the top of the toolholder. Circular feed of the spider casting was obtained with an integral worm wheel and cast-iron sleeve fitted to the spider stem on the dead-center end. The worm wheel meshed with a worm on a shaft supported by bearing mounted on the shaper table in front of the dead-center bracket.

When placed in the fixture, the spider had to be aligned perfectly with that part of the stem previously turned on a boring mill. This was done by attaching a dial indicator to the arm *M* and indicating first the top and then the side of the spider stem longitudinally, and finally holding the indicator in one position while the spider was turned with the circular feed attachment. Necessary vertical adjustment was obtained with the shaper table at one end of the fixture and screw jacks at the other end. What little horizontal adjustment was necessary was obtained by two steel brackets imbedded in concrete at each side of the fixture and fitted with a setscrew and locknut.

Although we were able to give a rotary motion to the spider, the space between the radial arms was not great enough to permit all the motion required for machining completely either the space between the arms or surfaces between the lugs on the outside of the casting. However, by revolving the main bar *M* of its own axis, which was done by loosening the bolts holding it to the shaper ram, by adjusting the over-arm *N* and its brackets on the arm *M*, all the required positions were obtained. When the ram extension *M* and over-arm *N* are positioned properly for each cut, the combined reciprocating motion of the shaper and circular motion of the feed attachment finishes the stem surfaces *C* between the arms and the surfaces *D* between the lugs on the outside diameter. While the cost of the fixture was rather high, it was more than offset by the results obtained.

Combinations Produce Missing Gage Block Sizes

By M. JACKER

Not all Johansson gage blocks can produce decimal sizes to thousandths and ten-thousandths inches; for example, the No. 2-A set of 31 blocks fails to produce quite a number of combinations in thousandths of an inch since the set does not contain gages for 0.001 in. up to 0.009 in. Consequently, as one example, 0.181 in. cannot be obtained.

However, it can be found within 0.0004 in. by simply adding some gage-block dimension in the set to 0.181 in., as for instance 0.101 in. to obtain 0.101+ 0.181 in. or 0.282 in., and then set the micrometer to the latter dimension. Then place the 0.101 in. gage on the anvil of the micrometer and caliper or fit a piece in the remaining space which will be 0.181 in. Similar combinations will give the missing sizes.

Armament

SECTION OF AMERICAN MACHINIST

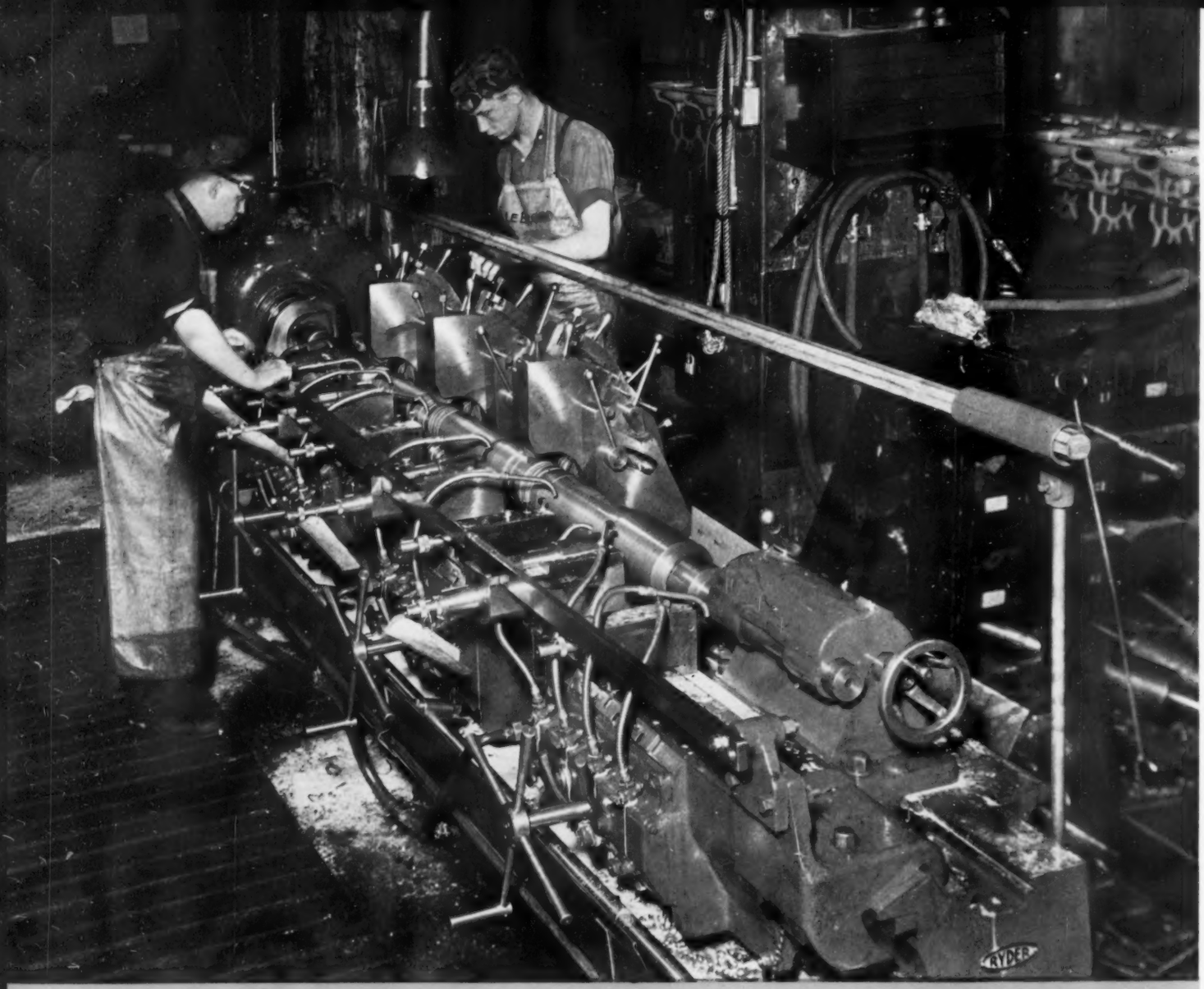
CANADA CARRIES ON

The Dominion's armament program now forms a vital contribution to the war effort of the British Empire. The stories that follow describe the activities of three of the many Canadian plants engaged in turning out products for waging war

Anti-Aircraft Gun Barrels

3.7-in. Shell Forgings

Bullets for Britain



The breech end, the adjacent parallel section and the taper are rough and semi-finish turned in two set-ups on a "Lo-Swing" lathe. Combining operations saves time, affords better concentricity of the various surfaces

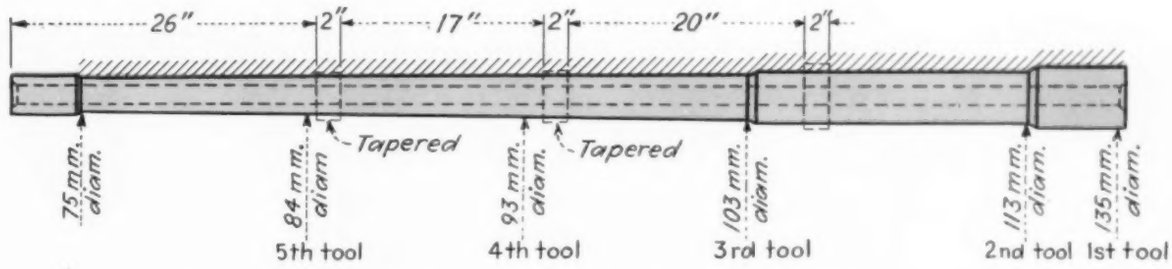
ANTI-AIRCRAFT GUN BARRELS

EARLY IN JULY a Canadian plant with no previous experience in manufacturing cannon got under way upon a large British contract for Bofors anti-aircraft gun barrels. Fourteen weeks later the first barrel passed inspection. October, the fourth month of production, witnessed completion of a sizable quota on time. The quota for November was twice that for the previous month, but it was finished several days in advance. Further lifts in production await delivery of much-needed American machine tools.

This record is made more remarkable by the fact that the shop started with 70 per cent unskilled labor. Technical school boys were chiefly selected for training under the direction of the few skilled men available. Gun making can be likened to "production

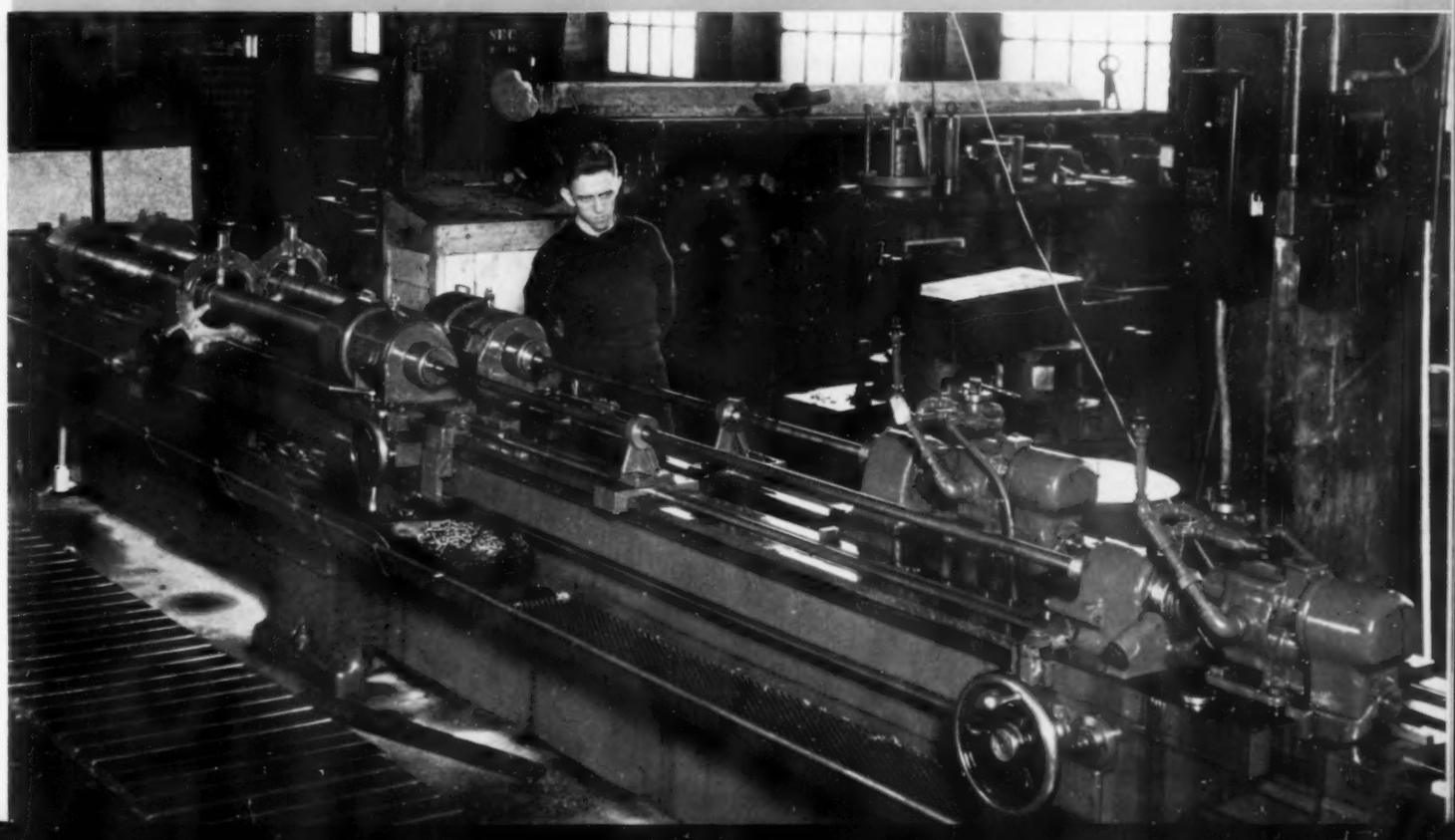
toolmaking." As the shop superintendent expressed it, "the boys do not know what a tenth or better is, so they go ahead and work to it." Of course, each machine set-up and its tooling were carefully worked out in advance to achieve and maintain accuracy at each step. The boys are drilled in the routine of a given set-up under the direction of a skilled man, after which the operator imparts job knowledge to one or two learners, before being rotated to other jobs. At present, the training program on the primary operations has grown to the point where some boys have been transferred to the domestic-goods machine shop, until such time as additional equipment is received.

The production sequence for the barrel has undergone several changes since the original plan was laid down in late 1939. The number of turning operations upon the barrel, for example has been cut down. To minimize error, well-supported roughing and semi-finishing cuts on the parallel and tapered sections of the barrel are handled in two set-ups on a multi-cut lathe instead of taking several light cuts here and there on engine lathes. A milling machine does all six operations on the breech end in one set-up in order to hold the

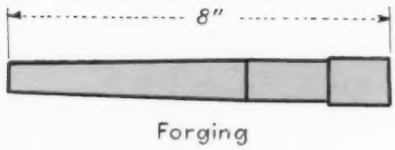


To support the barrel properly in the Lo-Swing, three roller tracks are turned by auxiliary toolslides before the roughing or the semi-finish turning operations

Deep drilling of the barrel is carried out on a Pratt & Whitney duplex machine. Muzzle end of the barrel is held in a tapered bushing and the drill bar is guided by a long bushing

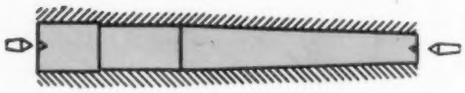


HOW TO MACHINE BOFORS GUN BARRELS



Forging

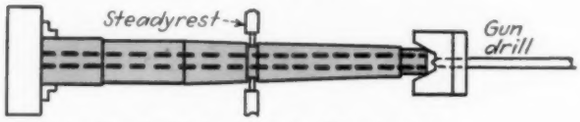
Oper. 1 – Center ends. Oper. 2 – Face B.E.



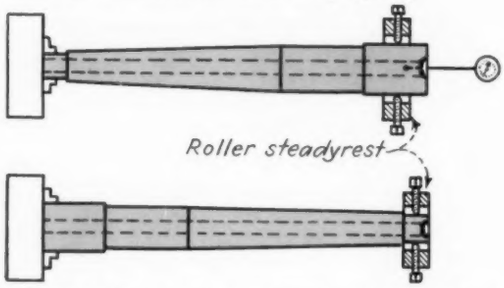
Oper. 3 – Turn O.D., leaving 8 mm., and spot

Preliminary operations on the barrel forging are designed to throw error from the drilled hole to the rough-turned O.D.

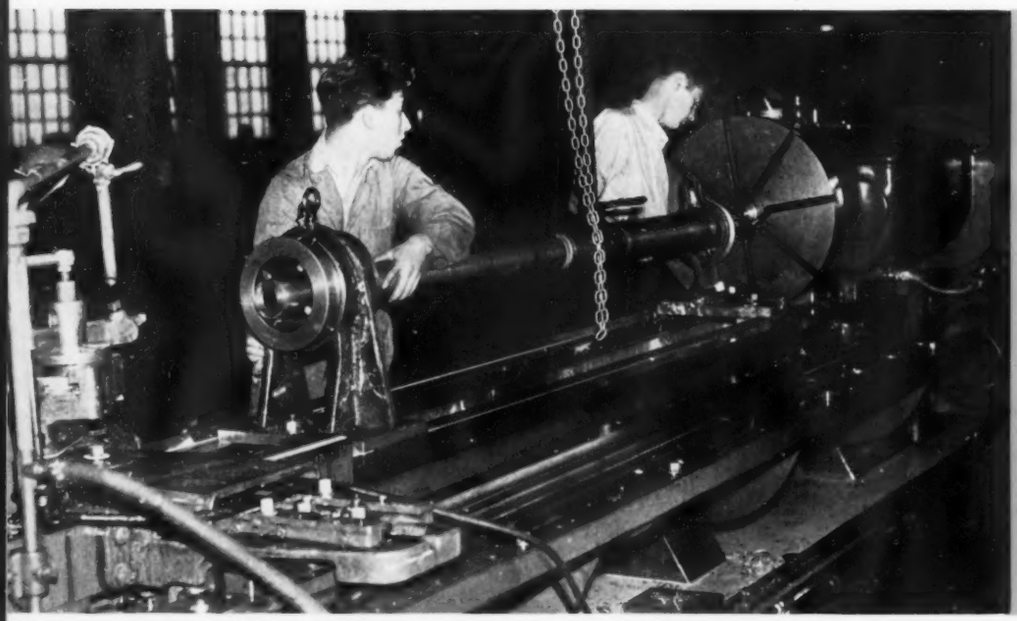
Oper. 4 – Turn M.E. to fit boring machine bushing and spot steadyrest track



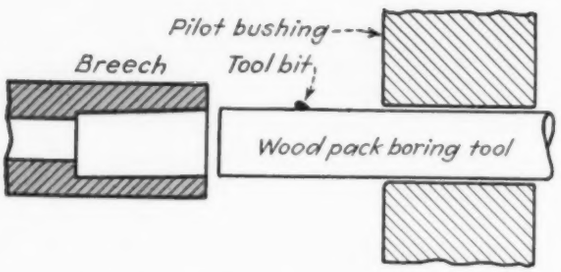
Oper. 5 – Drill to 1.42 in (Duplex)



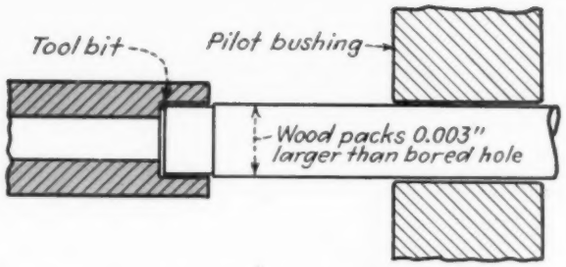
Oper. 6 & 7 – Cone breech end and muzzle end



Operations like coning and chambering, wherein the hole must be set up to run dead true at both ends, are performed on heavy engine lathes fitted with roller steadyrests. The end at the faceplate is caused to run true by means of an indicator bearing on an external test spot, while the opposite end is set true by an indicator contacting the hole periphery



Inaccurate Boring Set-up. If pilot boring is not "dead true," the boring tool will not correct the misalignment but will follow the pilot hole



Correct Boring Method. The boring tool cuts its own start, and the oversize woodpacks are shaved to size by the newly cut edge of the hole

vital surfaces in correct relationship with the datum line. By and large, the production sequence is fully established, but one or two operations may be changed in order to speed up output. An example is broaching the rifling instead of draw cutting with a single-point tool.

A Bofors gun barrel is not an easy piece to machine. Forgings are supplied in the heat-treated condition, and show an average hardness of 300 Brinell. The material is a nickel-chromium-molybdenum steel of 0.25-0.35 carbon and possesses a yield point of 45 British tons. Machining speeds and feeds are not set at the maximum for two reasons: (1) it is considered better practice to take a 1/16-in. cut at fine feed where a ⅛-in. cut with heavier feed might be thought possible, in order to maintain the desired accuracy and not set up strains in the forging, and (2) primary operations need not be run at the highest feasible speed until operators achieve greater skill, because there is no need to pile up several hundred gun barrels ahead of the finishing operations, where the bottlenecks exist. This policy has reduced scrap to an extremely low figure, while quotas have always been met or exceeded.

Seven primary operations are needed to convert the forging into a rough-turned and drilled barrel, with the hole established as the locating point for subsequent semi-finishing operations leading to boring. The first and second operations consist of centering the forging and facing the breech end, respectively. Facing the breech is done to provide a new surface for the forging heat number and barrel number, which must be transferred from the mid-section prior to rough turning.

Operation 3 involves rough-turning in two stages upon a "Lo-Swing" lathe. Before either cut is taken, three small steadyrest spots are turned on the barrel by means of three small auxiliary toolslides and three small steadyrests. After the spots are turned, the main steadyrest rolls are positioned on the spots and the main tool slides are advanced to machine the breech section, the adjacent parallel section and the long taper to the muzzle end. Two tools work on the tapered portion. From 3/16–⅜ in. of metal is removed, the work speed being 25 r.p.m. and the feed 0.013 in. The second cut removes another ⅛ in. of metal and brings the piece to within 8.0 mm. of final size. The feed remains at 0.013 in. for the second roughing cut, but the work speed is increased to 45 r.p.m. Total time for the operation amounts to 170 min. High-speed steel tools are satisfactory for this operation. They are ground to special gages because the tools actually lie above center and must be ground to cut at the center of the work.

In Operation 4, the muzzle end of the barrel is turned to 83 mm. diameter in an engine lathe, to fit the bushing in the Pratt & Whitney duplex deep-hole drilling machine. A steadyrest spot is also turned at the center for subsequent use on the deep drill.

For deep-hole drilling, Operation 5, the work is indicated and securely chucked at the breech end, the central turned spot is supported by a steadyrest and the muzzle end fits snugly into a free-running bushing that is slightly tapered internally. The special Pratt & Whitney single-lip drill bit is keyed and pinned to the bar which does not rotate, but which is fed through the muzzle bushing and into the work at 0.0011 in. feed per revolution. Work speed is 142 r.p.m. Sulphur-base oil is fed through the hollow bar and drill bit at a pressure of 175 lb. per sq. in. to clear out the chips. The drill bit is reground after each barrel, being set up for that purpose in a home-made fixture, with a step cam ground to the form of the drill-bit contour.

In a length of 8 ft. the hole is bound to deviate two or three thousandths from the barrel axis at the far end, and therefore no reliance is placed on the hole for further locating purposes. Hence, the barrel is coned in Operations 6 and 7. For coning, the breech or the muzzle end is chucked as the case may be, and the turned spot on the opposite end is inserted in a steadyrest. By means of four adjusting screws and an indicator, the run-out of the hole is set to zero all around the periphery. The hole is then coned by means of the lathe's compound rest. The piece is reversed and the operations are carried out on the opposite end. By this means, any error is thrown to the outside of the piece, where it

can be eliminated in succeeding operations.

To true up the external surfaces of the barrel, prior to boring the hole, two operations must be performed. In Operation 8, the barrel is again placed in the Lo-Swing for semi-finish turning to within 3 mm. of final size. The same tools are used as in the roughing operation, but the tool slides are set in to the new dimension. Steadyrest spots are turned by means of the auxiliary tool slides and steadyrests prior to the semi-finish turning operation.

Three locating surfaces for the boring set-up are machined on an engine lathe in Operation 9. The muzzle end is turned to 80.11 mm. diameter to fit the bushing in the boring machine, a central steadyrest spot is turned, and the breech section is skimmed 3 in. from the breech-end shoulder to provide a test spot concentric with the hole. Checking and straightening follow in Operation 10. Usually barrels require no straightening because of the care taken in setting up and machining during prior operations.

Every effort must be made to bore out the drilled hole in a manner that will assure minimum eccentricity, a high finish and little if any deviation relative to the axis in a distance of approximately 8 ft. Pilot boring was first tried. A pilot hole was bored to a depth of approximately 4 in., the wood-packed boring tool inserted and the complete hole bored. If the pilot boring was not chucked dead true (an operation requiring a skilled operator), the hole at the opposite end might be 0.010 in. off center. Once pilot boring was done, the boring tool could not correct misalignment. Besides, the wood packs were subject to uneven wear from running in an eccentric hole, thus contributing to further misalignment of the hole at the opposite end.

To overcome these conditions, the long wood-packed boring tool now runs in an extended pilot bushing which holds the tool in correct alignment while it cuts its own start. The bushing I.D. accommodates wood packs 0.003 in. larger in diameter than the 1.550 in. hole being bored. After the single-point cutting tool enters the hole, the over-size packs are shaved down to the hole size by running against the sharp edge of the newly cut hole. With the hole started correctly and the wood packs fitting the hole accurately, boring should be nearly dead true unless hard spots are encountered or the wood packs wear non-uniformly. Thus, the opposite end of the hole ordinarily comes true with the part axis within 0.002–0.003 in.

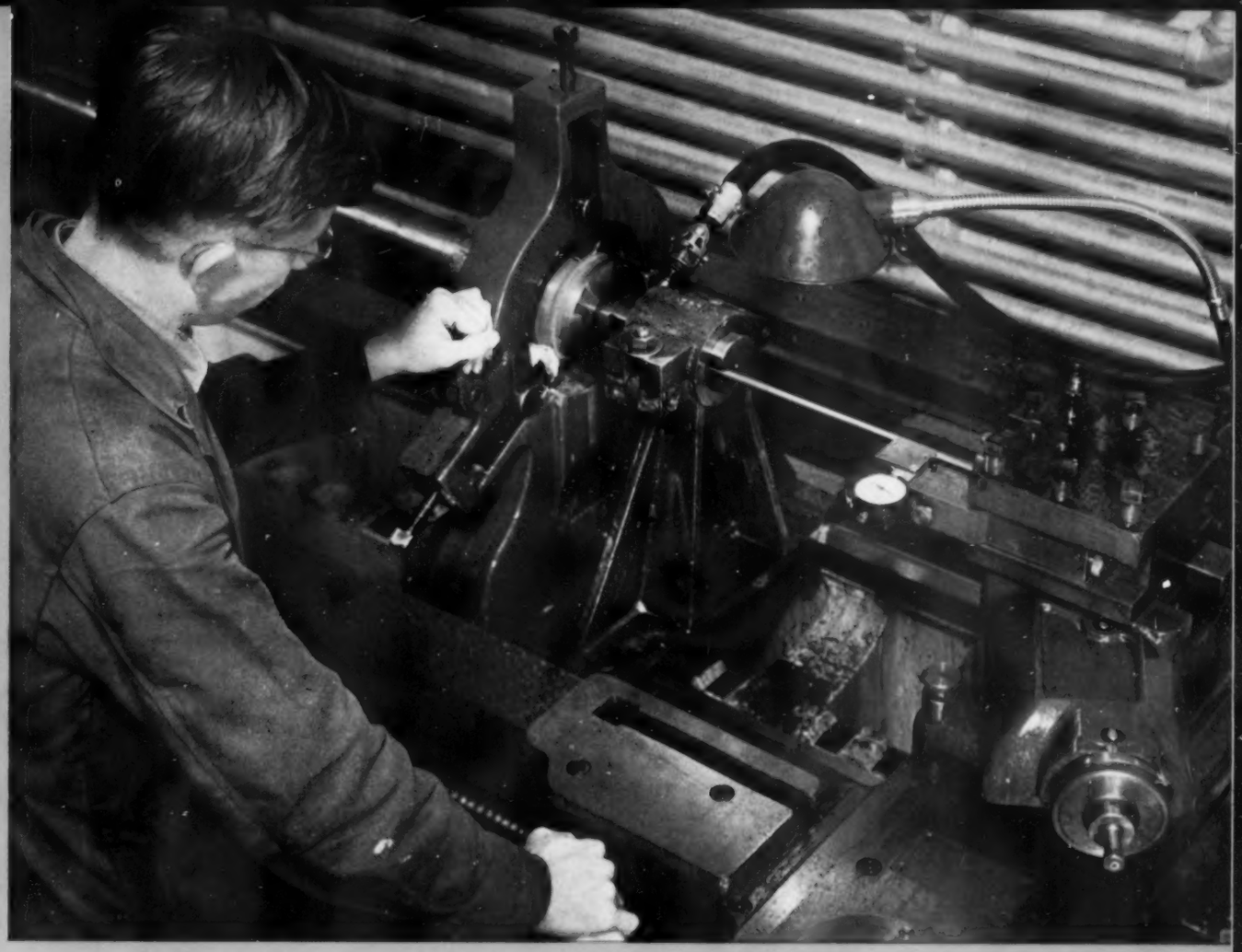
The feed per revolution is extremely small, since the work speed is 142 r.p.m. and the boring-bar feed (hydraulic) is set at ½ in. per min. The tool now used cuts on an extremely small radius, but may be superseded with a Davis-type arrangement. Total boring time averages about 3½ hours, floor-to-floor, some 20 min. being needed for set-up.

A second coning of the muzzle and breech ends of the barrel, Operations 12 and 13, throws any eccentricity remaining between the bore and O.D. surfaces to the outside of the barrel.

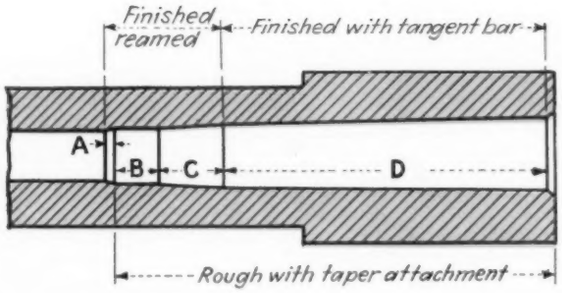
To speed up the finish-turning process, the parallel section adjacent to the breech is turned on one engine lathe, Operation 14, and the taper section is machined on a second engine lathe, Operation 15. In both set-ups it is required to finish turn the barrel to 0.5 mm. of final size, thus leaving about 0.020 in. for grinding. If necessary, the barrel is straightened during the checking process carried out in Operation 16. Only one barrel has been straightened so far.

Approximately 0.025 in. are removed from the bore by the honing process, which starts with the diameter of 1.550 in. and ends up with a 40-mm. hole, 0.01 mm. –0.00. This operation is carried out on a horizontal Barnes machine. If the barrel becomes too warm it is done in two stages; that is, all but the final couple of thousandths are removed and the barrel is set aside to cool thoroughly. The second honing brings the barrel to final dimension, and is easily done when necessary because setup time is not important. Total floor-to-floor time amounts to 2¾ hours. The honing tool is fitted with No. 38320 stones, I grade, and the stones last for approximately three barrels.

The parallel section and the taper are ground to size (0.020 in. being removed) in Operation 18. Grinding is a faster process than attempting to finish-turn to size, and



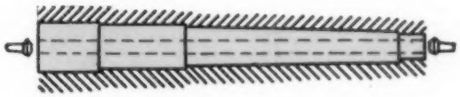
A tangent-bar fixture finish bores the long taper in the chamber. The tool-holder is contained within a dovetail slot in the tangent bar and is fed into the work by means of the pushrod fixed in the toolpost



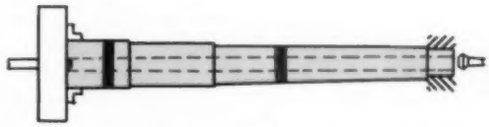
Outline of chamber in Bofor santi-aircraft gun. Tapers *B*, *C* and *D* are rough bored in one set-up. Taper *D* is finish bored with the tangent bar. Taper reamers are used after finish boring to cut taper *A* in order to blend taper *B* with the honed bore and to finish tapers *B* and *C*

Prior to boring, test spots and locating surfaces are turned on the semi-finish turned barrel in order to set up the hole so that it runs dead true at each end

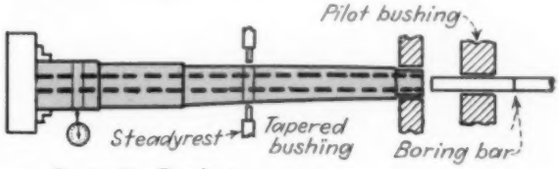
INTERMEDIATE OPERATIONS



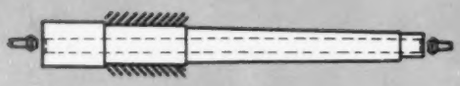
Oper. 8 – Semi-finish straight and taper sections and steadyrest spot



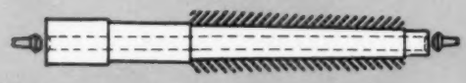
Oper. 9 – Turn muzzle end, turn test spot and skim breech end shoulder



Oper. 11 – Boring

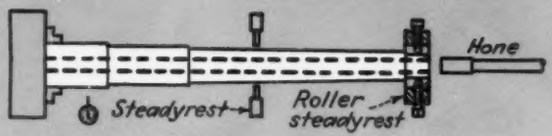


Oper. 14 – Finish turn parallel section

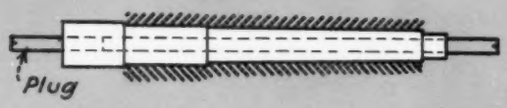


Oper. 15 – Finish turn taper section

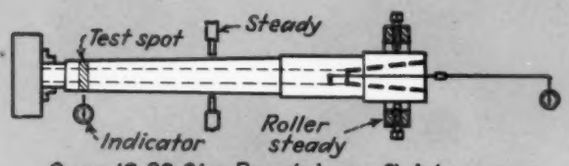
Before chambering the O.D. is finish turned and ground concentric with the honed bore



Oper. 17 – Hone

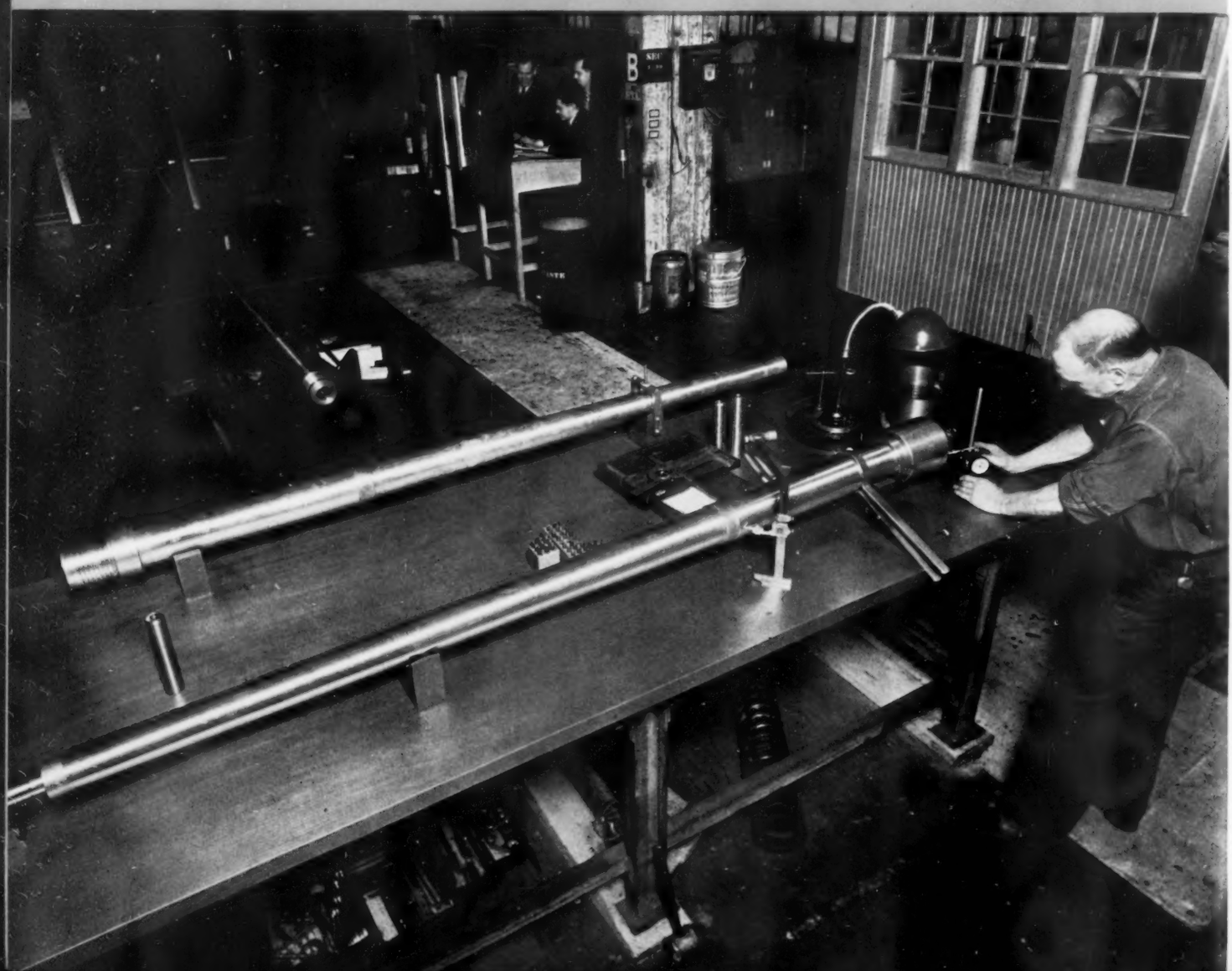


Oper. 18 – Grind O.D.



Oper. 19, 20, 21 – Rough bore, finish bore and lap chamber in separate setups

To mark the datum line for milling on the breech end, the barrel is set up on V-Blocks, the centerline of a slot established and a special marking gage run onto the breech thread



besides the resulting surface is free of tool marks that might promote cracks during firing. It is essential to grind the parallel section to 109.04 mm. diameter to fit the collet in the milling fixture employed during operations on the breech face.

The process of chambering is the most vital operation in the gun maker's manual, but it is also the slowest, and most difficult. Reasons: (1) the chamber must be dead true with the axis of the bore, (2) all tapers must be smoothly blended and a mirror finish is essential, (3) the chamber must show a 100 per cent bearing with the master plug gage.

The present chambering process involves three steps: (1) "rough boring" three tapers, a process that requires an average of two hours, (2) finish boring and reaming on a second lathe, a step that consumes six hours now but took longer while operators were being broken in, and (3) lapping with fine abrasive cloth on a third lathe, a process that is indeterminate in respect to time consumed. Three barrels may be lapped in five hours or one barrel may take three hours or longer.

Rough boring the chamber, Operation 19, is done on a Bertram engine lathe modified in the following manner: (1) a special tool block was fitted to the compound rest and bored in place to receive the boring bar after the compound rest was doweled to its slide and the cross-slide was doweled to the carriage, and (2) the taper bar on the taper attachment was removed in favor of a special cam bar incorporating the tapers.

The muzzle end of the barrel is chucked on the straight-turned end section and indicated on the test spot, and the breech end of the hole is indicated dead true in a roller steadyrest. The indicator for the breech end has a long 1:1 pivot bar that contacts the honed bore beyond the chambering depth.

For finish boring, Operation 20, the rough-chambered barrel is transferred to a second Bertram lathe, which has a tangent bar attachment for guiding the finish-boring cutter. The tangent bar consists of a taper plug with a dovetail slot along one side for the toolholder and a bronze bushing that supports the free end of the bar in the honed hole. The other end of the bar is rigidly supported in a heavy bracket that can be clamped securely to the machine ways.

The first step in finish boring is to secure an accurate set-up of the barrel so that its bore runs dead true. This is accomplished by indicating the test spot at the muzzle end and setting the bore dead true at the breech end by means of a tell-tale indicator reaching beyond the rough chamber. Second step is to position the tangent bar attachment so that its axis coincides with the hole axis, and so that the depth of insertion is a definite amount. Third step is to slide the dovetail toolholder containing a 5/16-in. bit into the tangent-bar slot and connect the free end with a push rod fixed in the turret. After all elements of the set-up are completed, a laborious and exacting procedure, the long taper is finish bored ready for lapping. Depth of boring is controlled by the turret indicator, which contacts the finished face of the tangent-bar bracket. Finish boring removes 0.0075 in. per side of hole. When tested with a plug gage, the long taper must show a 100 per cent bearing and its surface must be free of rough tool marks and scratches.

During reaming, the roughing reamer removes 0.005 in. from the two short tapers *B* and *C*, and cuts taper *A* to remove the ridge between the honed hole and taper *B*, as left by rough boring. Finishing reamers remove the final 0.002–0.0025 in. Reamed tapers must be free of tool marks and show 100 per cent bearing with plug gages.

British standard practice is used in checking the interior of the chamber. It consists of laying a thick strip of warmed gutta percha upon a hardwood wedge, inserting the whole into the chamber and driving in a second wedge, so that the gutta percha flows and makes an impression about 1½ in. on the arc by the full length of the chamber. Every tool mark and the condition of the blend or lack of it at taper junctions is clearly revealed on the gutta percha. This convenient test shows the operator what condition must be corrected prior to lapping.

For lapping the chamber, Operation 21, the barrel is transferred to a third engine lathe. Lapping is done with strips of abrasive cloth fixed to a hardwood stick approxi-

mately 4 ft. long. The stick is fulcrumed in the turret and the free end is weighted to apply light pressure to the lapping end. Gutta-percha impressions of the chamber are made periodically to check the degree of polish imparted by the lapping action. The final impression must be free of all tool marks and the tapers must blend smoothly.

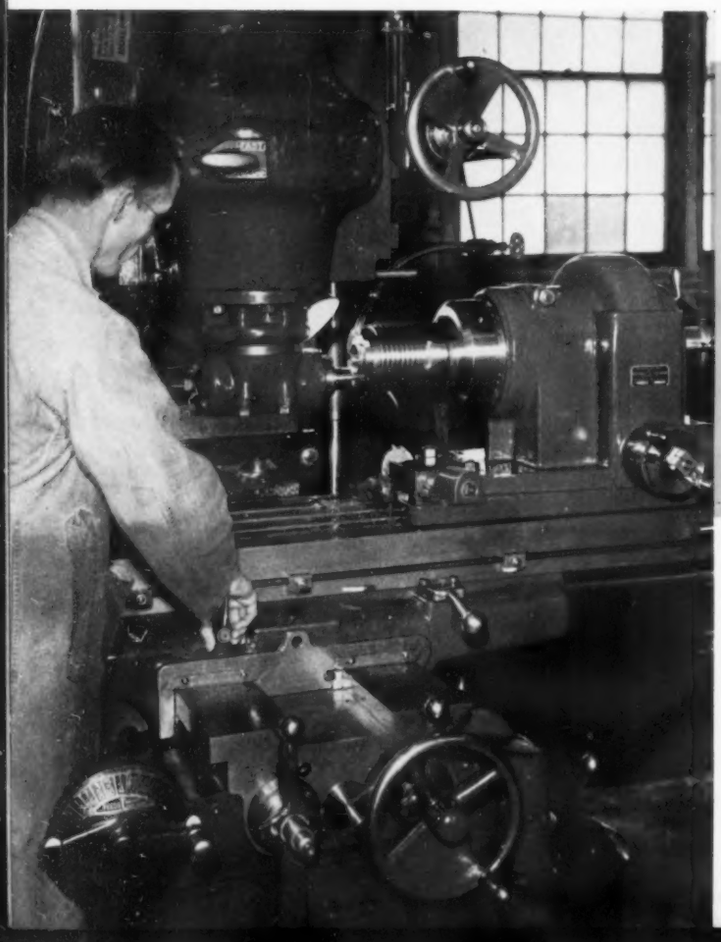
Several operations are required upon the exterior of the breech. These are combined on an engine lathe in Operation 22. The work involves turning the breech end to final diameter, facing the shoulder to length, grooving, peening a brass ring in the groove, turning the ring, and parting-off surplus metal from the breech face. Milling the buttress thread on the breech is done in Operation 23.

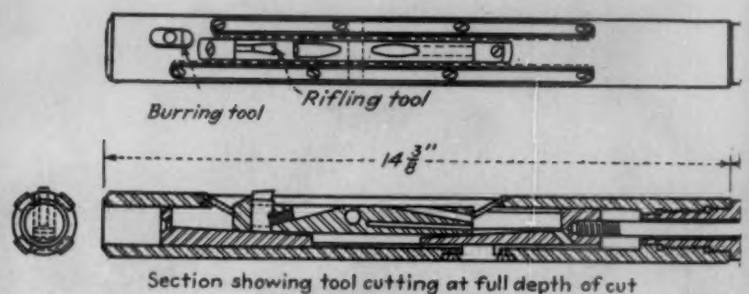
Rifling is at present done with a single-point tool, but this method may be superseded by broaching. The barrel is set up in a Le Blond rifling machine, which is provided with a fixture for cutting the long helical groove in the rifling bar. This operation is done initially when setting up the machine to a given rifling twist and need not be repeated until a new bar is required.

The rifling tool is of the draw-cut type and is fastened to the rifling bar. A draw rod passes through tool and bar and is connected to a geared feed wheel. When the rifling tool is pushed through the barrel, the draw rod collapses the toolbit below the rifling-tool O.D. in order to prevent scratching the bore. After indexing to the next cut and just as the draw cut begins, the toolbit is raised out to the set cutting depth by the action of the draw rod. The feed can be increased in small increments because a 3 in. graduated sector on the feed wheel represents 0.001 in.

Rifling is a time-consuming process because of the number of cuts involved. Sixteen grooves 0.022 in. deep must be machined around the periphery of the bore, but each cut amounts to not more than 0.0015 in. for the first 0.020 in. in depth. Previously, more shallow cuts were taken. Since the rifling is 0.022 in. deep, several finishing passes are required after the roughing cuts have reached the 0.020 in. depth. One part of lard oil to four parts of kerosene is used as a cutting compound. A brush fixed to the end of the rifling tool acts to clear stray chips.

Before the end face of the breech can be milled, it is necessary to set up the barrel





Section showing tool cutting at full depth of cut

Through the action of a draw rod passing through the pull bar, wedge surfaces within the rifling tool cause the toolbit to raise and lower. The toolbit is col-

Six milling operations are performed upon the breech face in correct relationship to the datum line. The barrel is set up in a Kearney & Trecker vertical miller equipped with a special power-operated and swiveling fixture. Here the operator is milling the extractor slots, which must be accurate, or else the extractor fingers will fail in high-speed firing of the gun

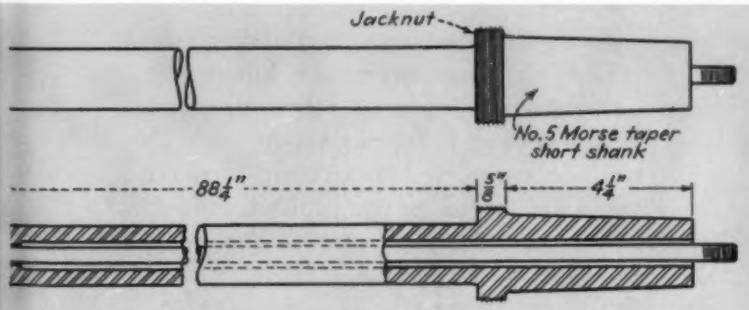
upon a surface plate and indicate the centerline at each end within 0.001 in. The centerline is indicated in relationship to a cross slot milled in the breech end-face during thread milling, and a special thread gage is applied to scribe a datum line in relation to the start of the milled thread. Milling and datum lines are marked in Operation 24.

Six cuts involving angular slots and a cam face must be milled in one set-up to assure accurate relationships. A Kearney & Trecker vertical miller fitted with a special pivoted power-driven fixture is chosen for this purpose, which is known as Operation 25. The barrel is held on the ground parallel section by the fixture collet and the outer end is raised to the horizontal centerline by means of a tapered bushing resting on a special stand. A steadyrest is also applied to hold the center.

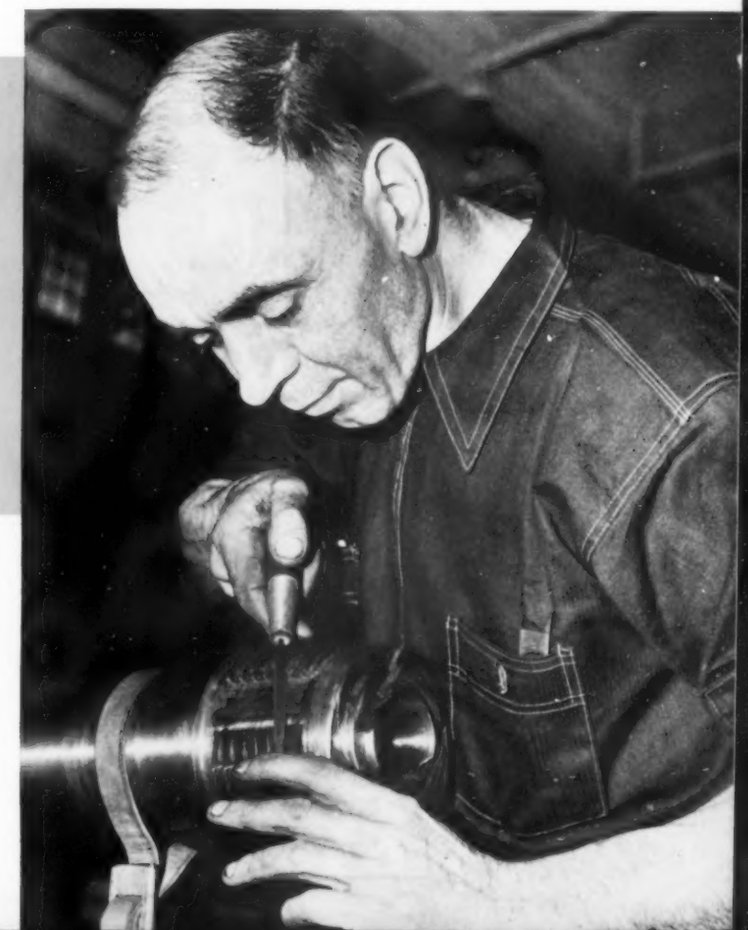
All milling operations are performed in correct angular relationship to the datum line. The barrel is rotated by means of a graduated collar and two central locating slots are milled. One of these is 12 mm. wide and at a certain angle to the breech face, the fixture being pivoted to the correct angle with respect to the machine bed. The second slot is milled at a steeper angle, and is wider. After these cuts, the piece is rotated 180 deg., and the extractor slots are milled. These are spaced a definite distance above and below the horizontal centerline of the piece in the established position. Part of each extractor slot is at right angles to the bore, and the remainder at an angle.

The milled cam face around the periphery of the breech end is obtained by rotary power feed of the fixture head through a telescopic drive from the low-lead gearbox. As a final operation, a slight taper is milled around the breech behind the thread.

Relatively minor operations are needed to complete the barrel. Interruptions in the thread are shaped in Operation 27. Five operations are combined on an engine lathe, being grouped in Operation 28. These consist of turning center steps, cutting the center thread, turning and threading the muzzle end for the flame guard and parting off excess stock on the muzzle. Five fitting, sub-assembly, drilling, parkerizing and final assembly operations bring the grand total of operations upon the barrel to thirty-three. Barrels are shipped elsewhere for proof testing.



lapsed into the body of the tool while pushing it through the bore for the next stroke and is raised to feed depth by the draw rod at the commencement of the return stroke for the draw out



Minor fitting operations are necessary upon the breech before final assembly

3.7-IN. SHELL FORGINGS

SINCE 1936, a Canadian plant has been making shell for the British Government, first on an experimental basis and now in mass production. One of the shell currently produced is the 3.7-in. high-explosive type. In many ways this shell is similar to the American 75-mm. high-explosive model, except that the base is thicker in order to permit machining a recess for the baseplate cover. Forging is of interest now that United States plants are setting up to produce artillery ammunition, because the method employed is a proved proposition, as indicated by a net production of 100 shell forgings per hour per forging unit.

The Stewart-Lloyd shell-forging process is a two-step method that involves: (1) producing the "bottle" by piercing a square billet, and (2) finishing the shell forging by drawing the bottle to correct diameter in rolls. Several advantages are obtained by doing the work in two stages: (1) the hole is accurately centered in the shell, and internal diameter and finish are such that no machining need be done, (2) the base thickness is held to 2.0 in. in *both* operations, which is essential for later machining, (3) there is minimum scrap loss in trimming, (4) loss from imperfect forgings is practically nil, and (5) piercing punches and drawing mandrels give maximum service between dressings.

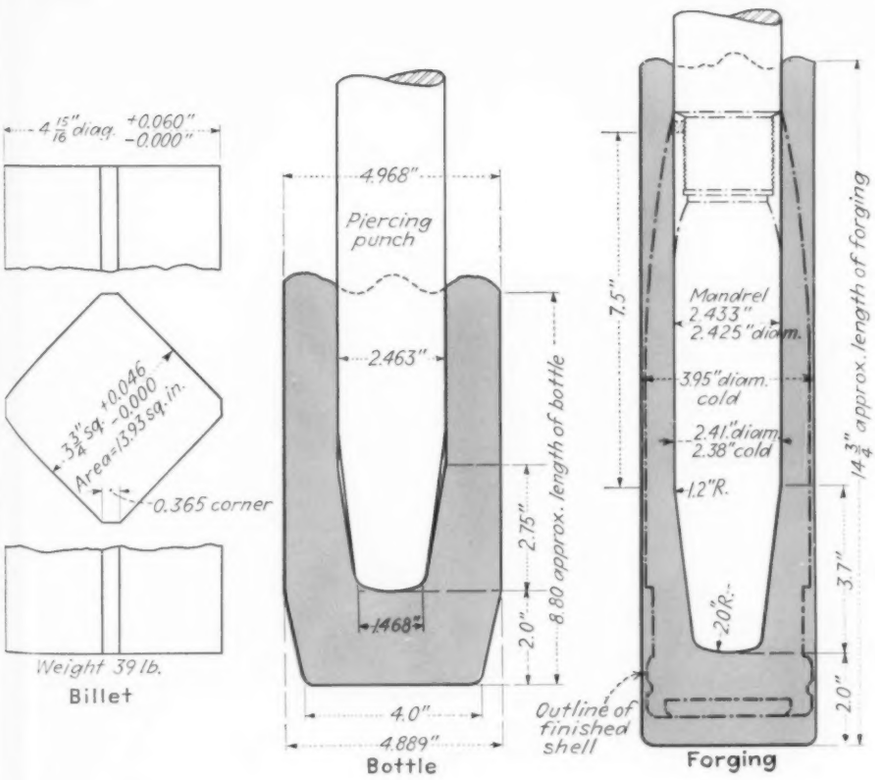
Shell steel is purchased in the form of $3\frac{3}{4}$ in. square bars with the edges beveled to fit the pot in the piercing die. These beveled edges also provide a four-point bearing of the billet against the wall of the die pot, so that the blank can not get out of center with the piercing punch. The punch merely opens the material out to fill the die-pot cavity. The steel analysis must conform with the British War Department's specification for a material that requires no heat-treating and will fragment properly upon bursting. In general, the material analyzes at 0.52 carbon and 0.80 manganese and possesses a yield point of 44,000 lb. per sq. in.

Bars are hot sawn at the steel mill to an exact number of multiples of the desired $9\frac{3}{4}$ in. billet length, plus cutting-off allowance. The maximum length handled in the special oxy-acetylene cutting-off machine is $100\frac{1}{2}$ in., which provides ten billets. But shorter lengths are accepted from the mills, providing they are cut to exact length for a definite number of pieces.

Bars are laid side by side upon the roller bed of the cutting table. They are gaged for length by the front gage bar, which parallels the structural steel track upon which the oxy-acetylene automatic cutting-off machine travels. Bars are also aligned against side rolls along one edge of the table. By the use of two gages, the bars are cut off dead square, which is essential in order to have the billet stand properly upon the piercing-die seat.

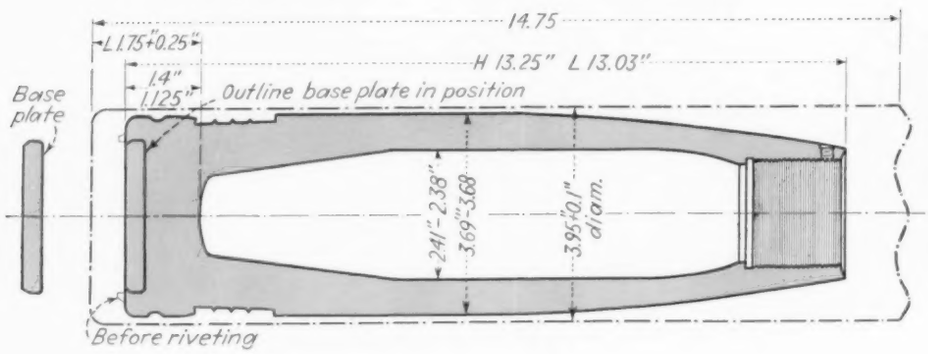
Two men operate each oxy-acetylene cutting-off machine. After the table is loaded and the cut begun, one operator precedes the machine with a hand torch to heat the beveled joints between bars. This is necessary to secure satisfactory operation of the automatic cutting-off flame without using special means to compensate for the notched effect in the work. The other operator stacks the cut billets, removes flash and stamps the identification. Production amounts to 54 billets per hour per machine, two units being necessary to keep step with each forging set-up.

Billets are transferred to a rotary furnace, where they are placed on end in three concentric rows around the perimeter of the rotating ring that forms the hearth. Maximum allowable thermal head is 2192 F., and the billet temperature at discharge is approximately 2,080 F. There are three heat zones in the furnaces: heating, soaking and unloading. All zones have temperature accurately controlled by indicating and controlling pyrometers. Full arch construction is used in the furnace, with burners firing across the work rows from both sides and vented at the hearth level, with the vents carried up within the inner and outer walls. Between the loading and unloading doors there is an arch with



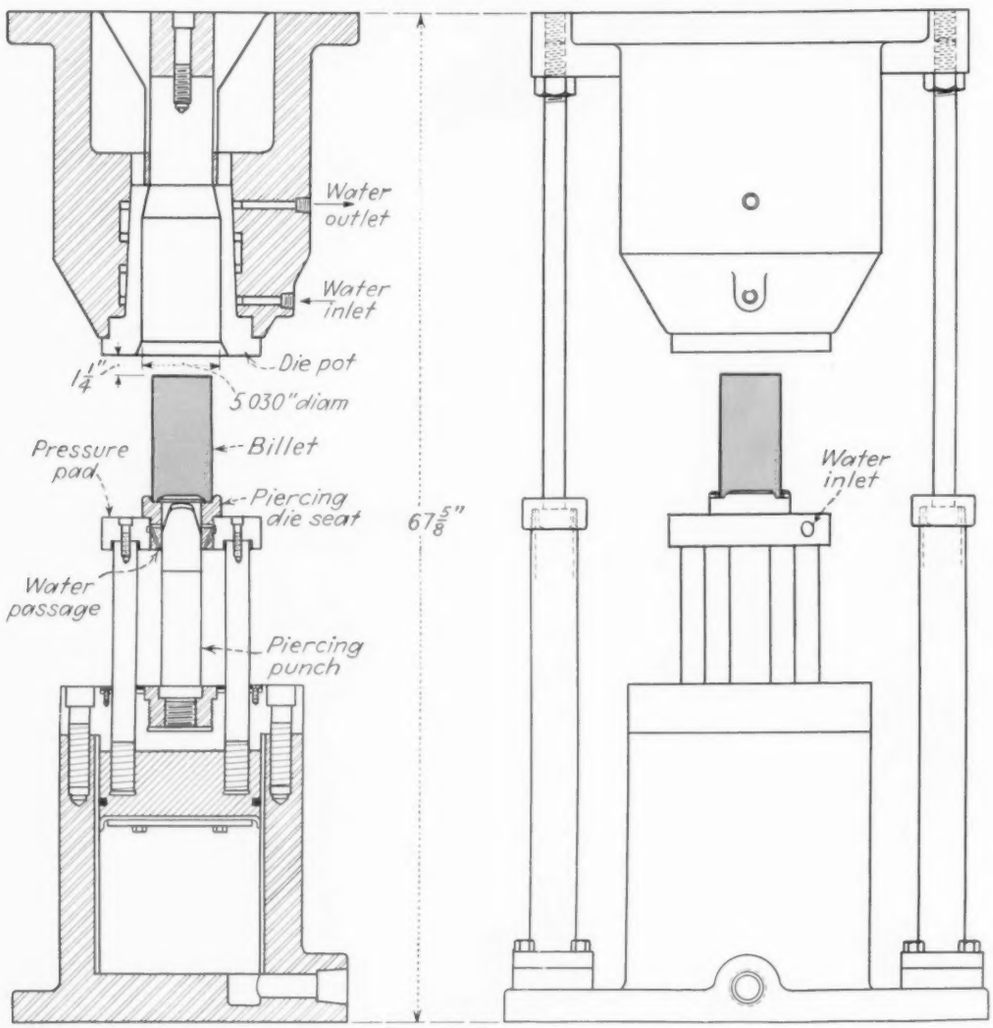
Billet cutting is handled by two men serving an automatic oxy-actylene cutting-off machine. One man preheats bar steel ahead of the machine torch the other stacks and chips the shell blanks, and stamps identification

In the Stewart-Lloyd forging process, the shell is made in two steps: (a) piercing a square billet, (b) drawing the bottle so produced in rolls in order to reduce the diameter and draw out the length. Both operations must produce and maintain a 2-in. base thickness. Underlined dimensions are finished sizes and will not be subsequently machined. Dot and dash lines represent the outline of the machined shell. Thickness of the forging wall, due to the eccentricity of the cavity at any point, must not be less than 0.74 in., because the finished wall thickness must come within 0.62-0.67 in.



The forging for the British 3.7-in. shell differs from American high-explosive types chiefly in the thicker base, which provides metal for machining a recess and a riveting edge for the base-plate cover. American practice calls for a cover spot-welded to a thinner base

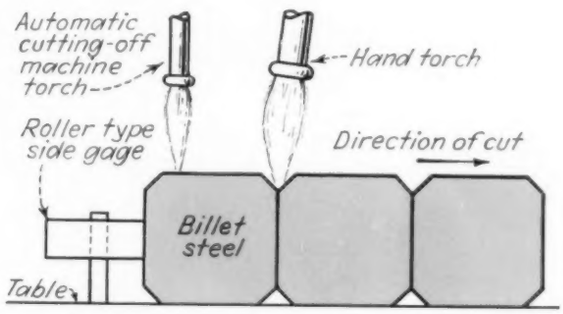
A centralized hole is assured by the "inverted" piercing method. Upon the down stroke, the die pot first engulfs the billet and the locating pad before striking the piston-supported pressure pad. As the pressure pad recedes, the die pot forces the billet over the stationary piercing punch, which is piloted by the locating pad



clearance beneath to allow billets standing on end to pass under. At the right of the unloading door there is a burner directing hot gases below the dividing arch to prevent newly charged billets from cooling the soaking zone.

Weight of each billet is 39 lb. Thus, with a net production of 100 billets per hour, 3,900 lb. of material are heated, although the furnace has a rated capacity of 5,000 lb. per hour. Consumption of 540 B.t.u. amounts to 338 cu. ft. of gas per 100 lb. of steel.

Three men are required to handle cold and hot billets. One man loads the furnace. A



A hand torch is used to preheat the billet steel ahead of the automatic machine, because the notched effect between bars would otherwise affect the efficiency of cutting off

helper removes the heated billet from the furnace and drops the piece upon a pallet. A second helper scrapes scale from the billet. Foot-operated air valves are conveniently placed to control the opening and closing of the loading and unloading doors of the furnace.

A vertical 350-ton four-column hydraulic press is employed for the piercing operation. Vertical die space is 63 in.; maximum stroke, 30 in., and right to left distance between columns, 26 in. Hydraulic line pressure is maintained at 1,700 lb. per sq. in. This pressure, plus a 3-in. valve upon the press itself, assures an ample supply of fluid at correct pressure to the cylinders which operate the upper and lower dies, respectively.

The upper die consists of an outer steel casting recessed internally for water-cooling the die pot. A floating stripper bar, moved by two side rods during the upstroke, causes a plunger to extract the forging from the die pot, from which point the pierced bottle drops to the locating pad for removal to the drawing press.

The bottom die consists of a hydraulic cylinder with the piston supporting four pressure pins. A circular pressure pad is mounted on top of the pins and carries a four-pronged locating pad. The pad is a sliding fit in the die pot, and also serves to guide the stationary piercing punch, which is threaded and seated in the cylinder head. Thus, the billet is accurately located in the die pot by its beveled edges, and the piercing punch is guided by the locating pad which has entered the die pot. Through this arrangement, the hole must come central in the forging. The concentricity maintained in piercing is extremely close, because the subsequent drawing operation reflects any inaccuracy which might occur if means were not provided for its prevention.

In operation, the billet is placed on the piercing-die seat, or locating pad. A proprietary oil is applied to the punch prior to the down stroke, although a mixture consisting of one part of graphite to five parts of quenching oil has been used as a lubricant. When the press is tripped, the upper die comes down and the billet is engulfed in the die pot. Continued travel of the upper die causes the pressure pad and pins to recede, although constant pressure is maintained in the lower cylinder. Upon the upstroke, the pressure pins and pad follow the upper die to strip the shell bottle from the piercing punch. Mention has been made of the means employed for removal of the forging from the die pot.

Three men are required to run the piercing press. One man operates the controls, a helper places the billet in the dies, and a second helper removes the forging and places it in a small gas-fired furnace for reheating. The furnace holds two shells. Reheating makes the material more plastic and thereby eases the strain on the drawing rolls used in the second operation.

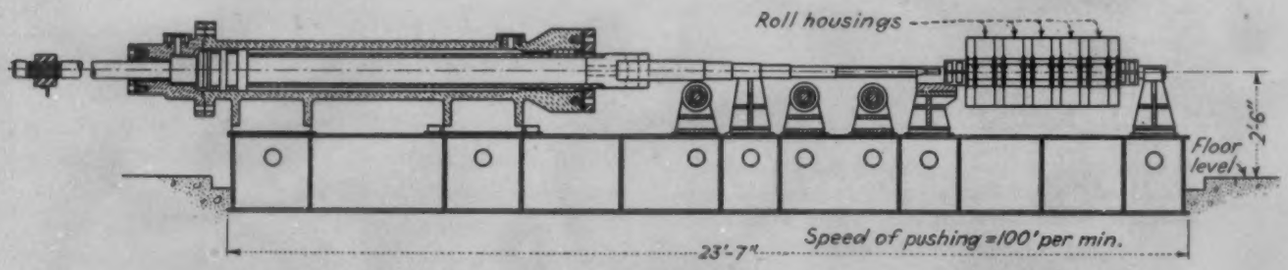
Shell forgings can be produced theoretically at the rate of four per minute by this set-up, but adequate time must be allowed for the piercing punch to cool, for changing the pierc-

ing punch or die pot when scored, and to allow the men to rest or change places with fresh operators. It must be remembered that these men are pulling 3,900 lb. of steel per hour out of a furnace or lifting it from the floor into the dies. Besides they must contend with heat and the long work week brought about by war conditions.

One of the most important factors limiting the speed of shell production is the danger of drawing the temper of the piercing punch if allowed to remain too long in contact with steel at nearly 2,080 F., or if insufficient time is given the punch to cool. Once the temper is drawn, the punch galls or scores and thereby affects the internal finish of the shell.

In the set-up described, the machine cycle requires 8 sec., during which the piercing punch is in contact with the metal for perhaps 4 sec. Upon completion of the upstroke, an auxiliary water jet is applied to the punch in addition to the water that flows through numerous small vents in the pressure pad. Circulating water surrounds the upper die liner, and flows continually. The hot metal parts are cooled so that they barely generate steam. Even so, satisfactory punch service between dressings amounts to only about 100 shell. Three dressings per punch afford the tool a life of about 300–400 forgings. Punch changes require from five to ten minutes, and are made practically once in every hour. The loss of time incidental to hot forging operations of this nature plus the exacting requirements for accuracy reduce the theoretical maximum output.

Naturally, a great deal of experimentation has been done and is being continued with materials for piercing punches. A hot die steel that has given as good service as any material tried to date has the following composition: 0.30 carbon, 0.30 manganese, 11.0 tungsten, 3.25 chromium and 0.40 vanadium. Heat-treatment consists of: annealing at 1550 F. for two hours per inch of thickness and cooling slowly in the furnace; preheating slowly to 1200 F. for two hours, then to 1500 F. for fifteen minutes; remove and cool in still air. Tempering is performed as follows: first draw in salt bath at 1300–1350 F. for two to three hours and cool to 300 F.; second draw, 1150–1200 F. for two hours and cool in still air. Hardness obtained is 30–32 Rockwell C.

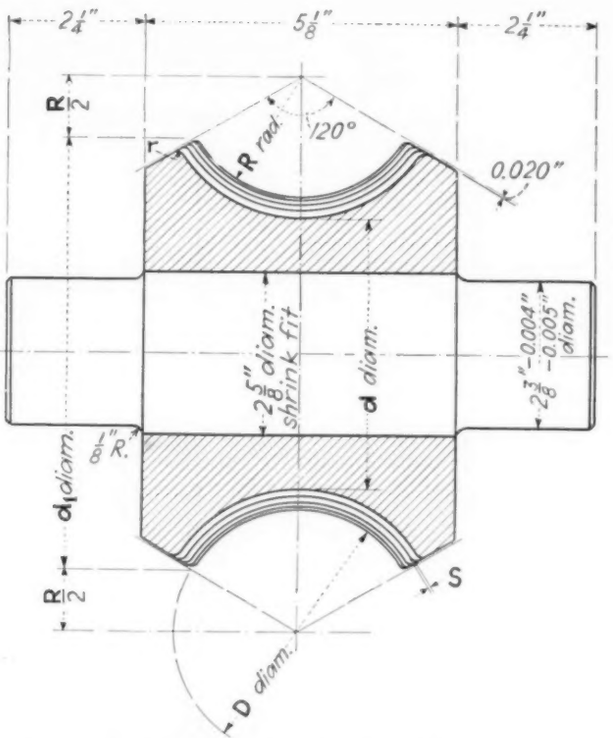


Rolling the forged shell bottle is done in a 75-ton hydraulic press. The bottle is loaded upon a mandrel and pushed through five sets of reducing rolls

Two purposes are accomplished during piercing: (1) the square billet is opened out to a diameter slightly in excess of the diagonal distance across the billet, and (2) the bottom is tapered to promote drawing the bottle to the diameter and length desired in the forging. The drawing operation on the 3.7-in. shell involves loading the bottle upon a mandrel that fits the pierced hole, and pushing the piece through five sets of reducing rolls. This operation is performed on a 50-ton horizontal hydraulic press, which has a maximum stroke of 75 in.

The pierced billet is laid in a V-block in front of the roll housings, and a control valve is tripped to advance the mandrel. This tool is approximately 0.030 in. smaller in diameter than the piercing punch, because the billet

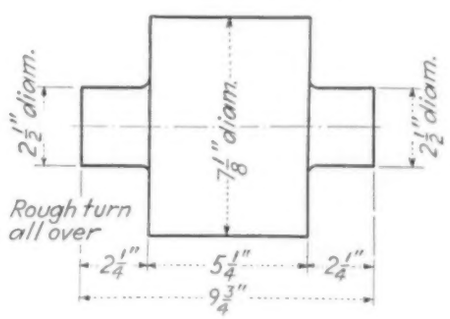
Spare roll housings and redressed rolls are kept in the tool room. Maintenance of the bronze roll bushings is the chief problem



Roll Dimensions in Inches

Part No.	D	R	S	r	d	d_1	R/2
1	4.6277	2.3138	0.032	0.157	4.3723	6.6861	1.1569
2	4.3939	2.1969	0.032	0.118	4.6061	6.8030	1.0984
3	4.1902	2.0951	0.024	0.118	4.8098	6.9049	1.0475
4	4.0664	2.0332	0.024	0.079	4.9336	6.9668	1.0166
5	4.0027	2.0013	0.020	0.079	4.9973	6.9986	1.0006

When roll is to be made in one piece Order roll blank to these dimensions



Rolls ordinarily last for 25,000 shell before redressing. The greatest reduction is done in the first three stages, and consequently the finishing rolls can be reclaimed for the "breakdown" stages

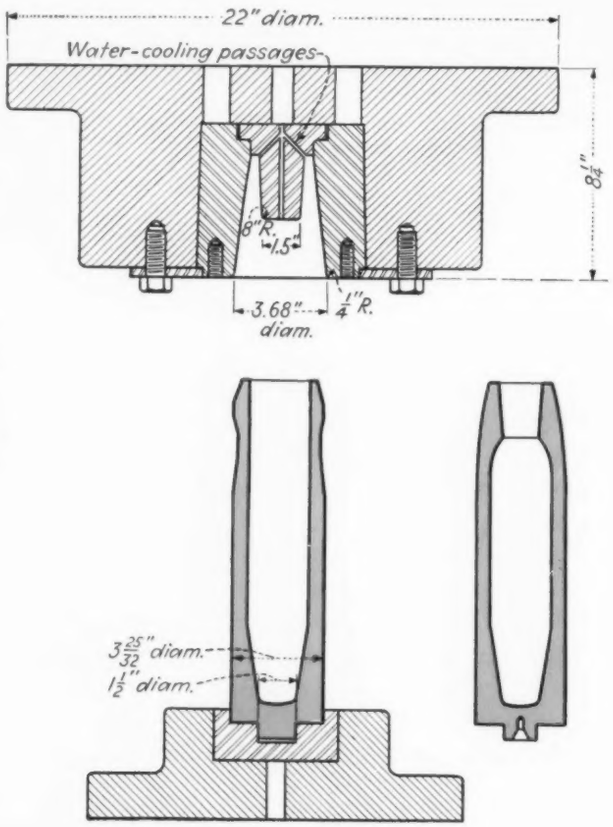
temperature has dropped somewhat. After the mandrel bottoms in the shell cavity, it carries the piece through the five sets of reducing rolls at constant speed. Upon emergence from the last set of rolls, the stroke is automatically arrested and two spring-actuated strippers drop against the mandrel behind the open end of the forging. When the return stroke takes place automatically, the shell is stripped from the mandrel and drops into an apron, whence it is removed for stamping and transfer to a sand bed for cooling.

By reducing the shell bottle in a sufficient number of stages (five in the case of the 3.7-in. shell) the thickness of the shell base is not disturbed. Experience shows that by starting with a properly centered pierced hole, the concentricity of the internal and external diameters is not altered in the drawing operation.

Each steel roll housing incorporates three radially arranged rollers, which are mounted in bronze bushings. Rollers may or may not be integral with their arbors, but they are not permitted to float. Alignment of housings in respect to each other is attained by clamping them upon round guide bars in the machine.

Rollers are produced from heat-treated steel with the following analysis: 0.55 carbon, 0.55 manganese, 0.75 chromium, 1.60 nickel, and 0.75 molybdenum. One set of rolls will produce 25,000 pieces. Journal bushings require more maintenance than rolls, hence spare roll housings are kept in the toolroom. Incidentally, draw rings have been tried for shell forging operations, but do not give as long life as rollers.

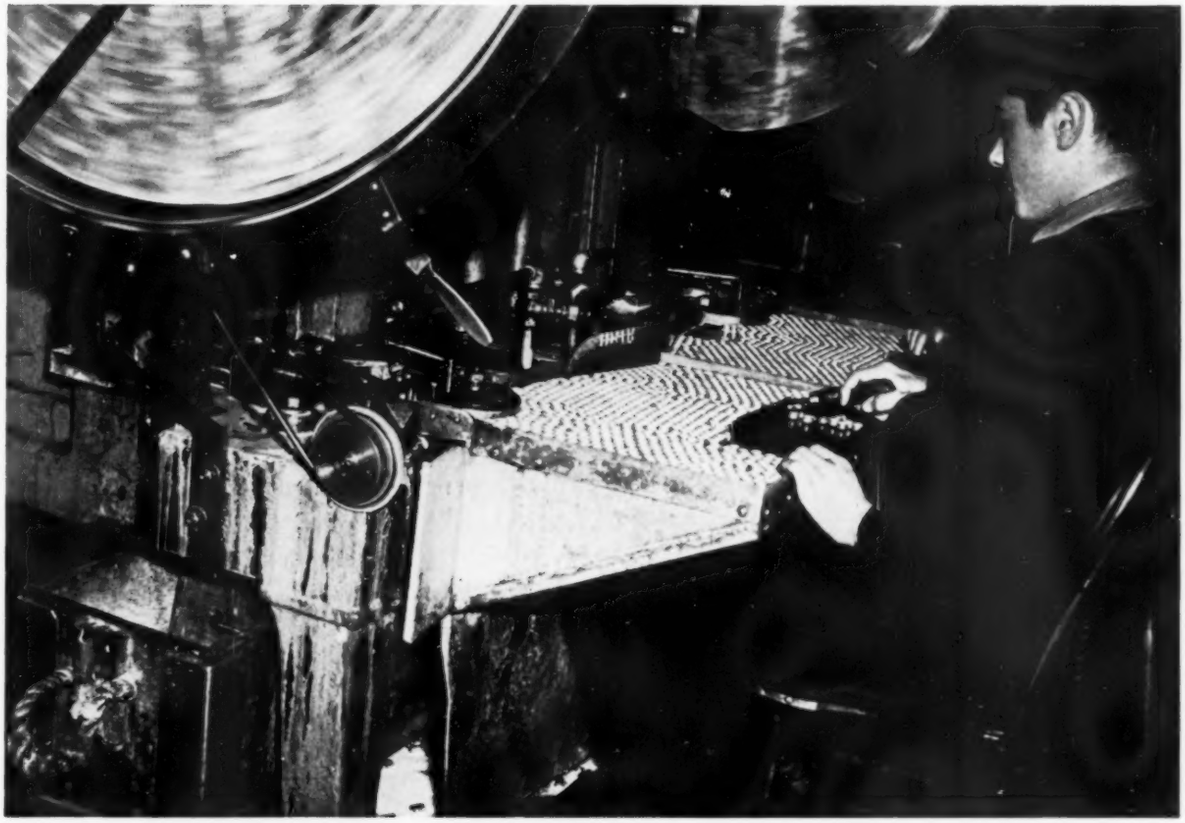
The finishing mandrel, or tip, is not put to the severe service encountered by the piercing punch, and hence has a life of about 1,500 shell between dressings. The mandrel is made of the same material as the piercing punch and is heat-treated in the same way. Proper lubrication and cooling are important. Prior to the forward stroke of the mandrel, it is swabbed with a mixture of one part graphite to five parts quenching oil. Upon completion of the return stroke, a ring water jet and a hose in the hands of the operator reduce the temperature of the mandrel so that it barely generates steam. The hot forgings are closely stacked on end in a sand bed so that they do not dissipate heat too rapidly, and hence practically normalize themselves.



Nosing is done hot after rough turning the O.D. contour and facing the ends. Only the nose of the shell is heated to 1830 F. in a porthole-type gas-fired box furnace before nosing in a 115-ton single-acting four column hydraulic press

BULLETS FOR BRITAIN

The Dominion Arsenal steps into the breach as a quick source of ammunition while other facilities are building



The first drawing operation on the cartridge case is done in a vertical press. The brass cups which have already been formed from sheet stock are carried into the machine by means of an automatic dial feed driven by the belt at the left

CANADA'S ARSENALS, like those of the United States, are designed to keep the art of munitions making alive during times of peace. As in the case of other countries, Canadian appropriations for national defense reached a low ebb during the pacific 20's and during the first years of the depression when economy was the watchword and governmental expenditures were cut to the bone. It is said that during this period one member of the Canadian Parliament proposed that the year's expenditure for defense items be limited to $1. Such drastic curtailment of course was never approved, but the mere fact that it was seriously considered reflects the extreme reluctance to contribute to the military establishments that existed only a few years ago.

The Dominion Arsenal today affords an interesting contrast between the old and the new. Many of the methods and much of the equipment antedate the World War and some of it goes back to the close of the last century; by way of contrast there are modern hydraulic presses, three up-to-date continuous annealing furnaces and the latest toolroom equipment.

The products of Dominion Arsenal are small arms ammunition and cartridge cases for artillery ammunition ranging up to the 18 and 25 lb. shell sizes. During the World War the arsenal served chiefly as a pilot plant lend-

ing its experience and personnel to instruct other manufacturers in correct tooling and processing. Today the Dominion Arsenal again fills this function and in addition has gone into the mass production of ammunition. It has jumped quickly into the breach to create a source of supply of these highly important armament items while larger facilities are in the process of construction.

Raw materials—copper, lead, nickel and zinc—are brought into the arsenal in the form of pig metal. The arsenal does its own melting, casting, rolling, and annealing to produce the sheets and strips used to fabricate its products. Cartridge cases are made from standard cartridge brass. Bullets consist of cupro-nickel jackets filled with aluminum points and lead slugs. The aluminum is purchased as wire but the lead is melted and extruded into wire before being upset into slugs at the arsenal. Detonating caps are made of copper containing a small percentage of zinc.

The small arms cartridge made at the Dominion Arsenal is the standard British .303 which serves for the Enfield rifle and the light Bren machine gun. Needless to say, a high degree of precision is required for machine gun cartridges. A Spitfire plane may have eight machine guns in the leading edge of the wings all inaccessible to the plane's crew. Ammunition that invites the slightest risk of a jammed gun cannot be tolerated.

Because of the need for quick expansion of output, little has been done in the way of experimentation or the adoption of radically new methods of manufacture at the Dominion Arsenal. It was felt that single operation machines of the type that had already stood the test of high production service would cause fewer delays than the more complex multiple operation designs. Where additional equipment has been added, the operating principles of the older machines are followed.

In the event of a breakdown on the single operation machine only one unit of a battery is affected causing a minimum disruption of production. The hand feeding required is done by boys below military age, most of them sixteen to eighteen years old.

Blanks for the cartridge cases are punched from the rolled brass strips. These are then cupped and given a series of four draws with an annealing and a pickling operation after each of the first three. At present this work is done in batch type furnaces and tanks but a continuous washing, annealing and pickling machine is now being installed for the .303 cartridge cases. After the third draw the

In order that they will not crack when the bullet is forced into them, the open ends of the cases are annealed. The parts are put into two rotating dials, carried through gas flames and pour out through tubes into a tote box beneath the machine

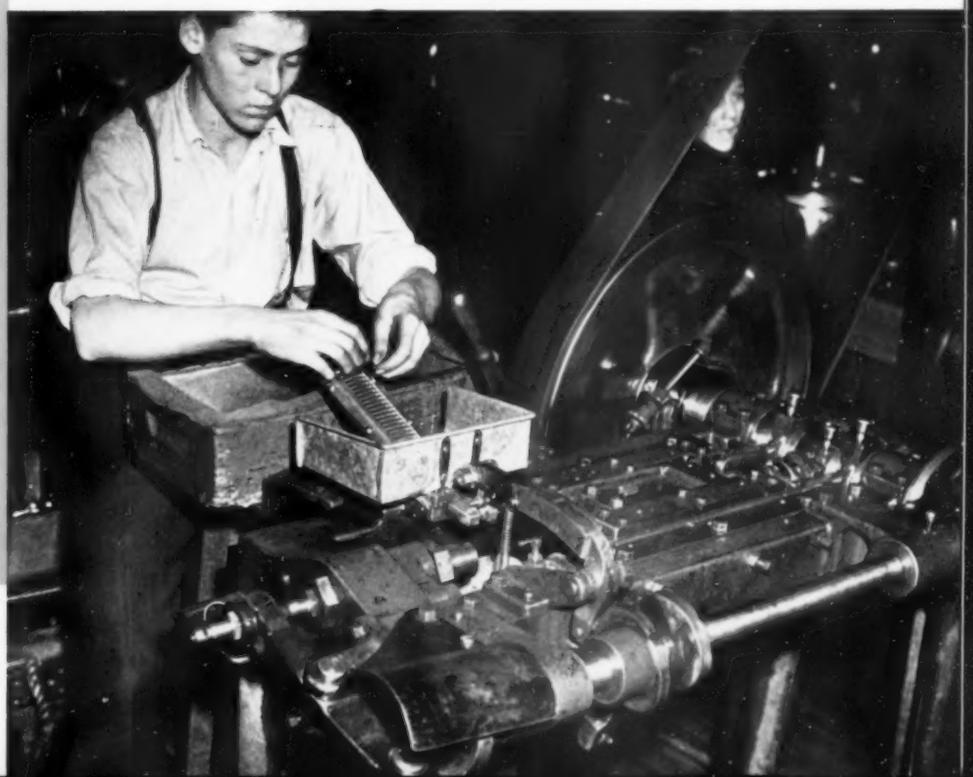
cases are trimmed to length; after the fourth draw they are tapered in two steps, indented for the detonating cap, headed and pierced. The cases are then semi-annealed, that is, they are passed through a series of gas flames which heats the tapered ends leaving the lower part cool while the work is being carried by means of a continuous dial feed. A thorough washing, rinsing and drying by tumbling in sawdust makes the cases ready for filling.

Bullets are given three draws and two pointing operations. Because of their shorter length and the difference in the material, annealing is not required. The bullet shells are then filled by hand, first with the aluminum points, then with the lead slugs. The filling is driven home on a horizontal press and secured in place by means of two crimping operations on a similar kind of machine. The bullets then go through the "canneleuring" operation in which an annular groove is rolled near the blunt end. This groove is used in their assembly to the cartridge cases. The bullets are then rectified, or brought to their final size, in another horizontal press.

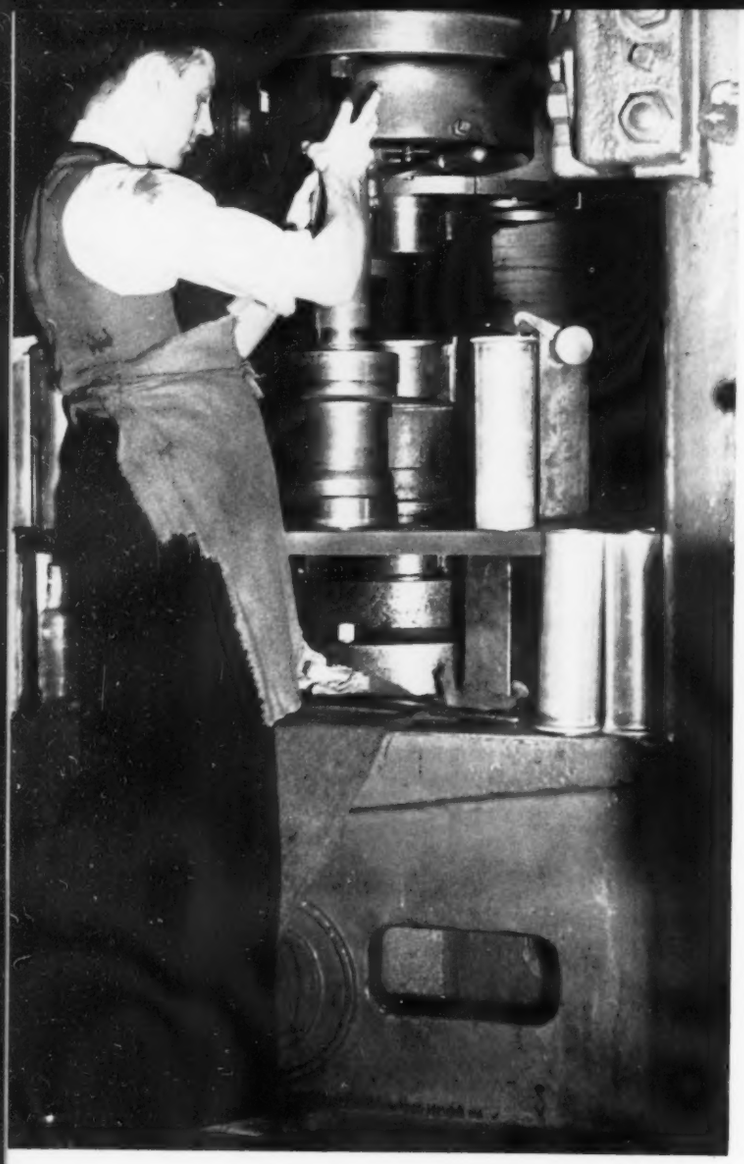
A new automatic machine, now in the process of installation, will complete detonating caps in one set-up.

Cases for artillery ammunition are made in a modern building next to the small arms

After the bullet shells have been filled with aluminum tips and lead slugs, they are closed in this crimping press. As in similar operations in the arsenal, the work feed is arranged to reduce the possibility of accident



Heading the small arms cartridge cases is done in horizontal presses such as these. The parts are fed into a chute which carries them to the working position between the dies. An inspector checks work in process



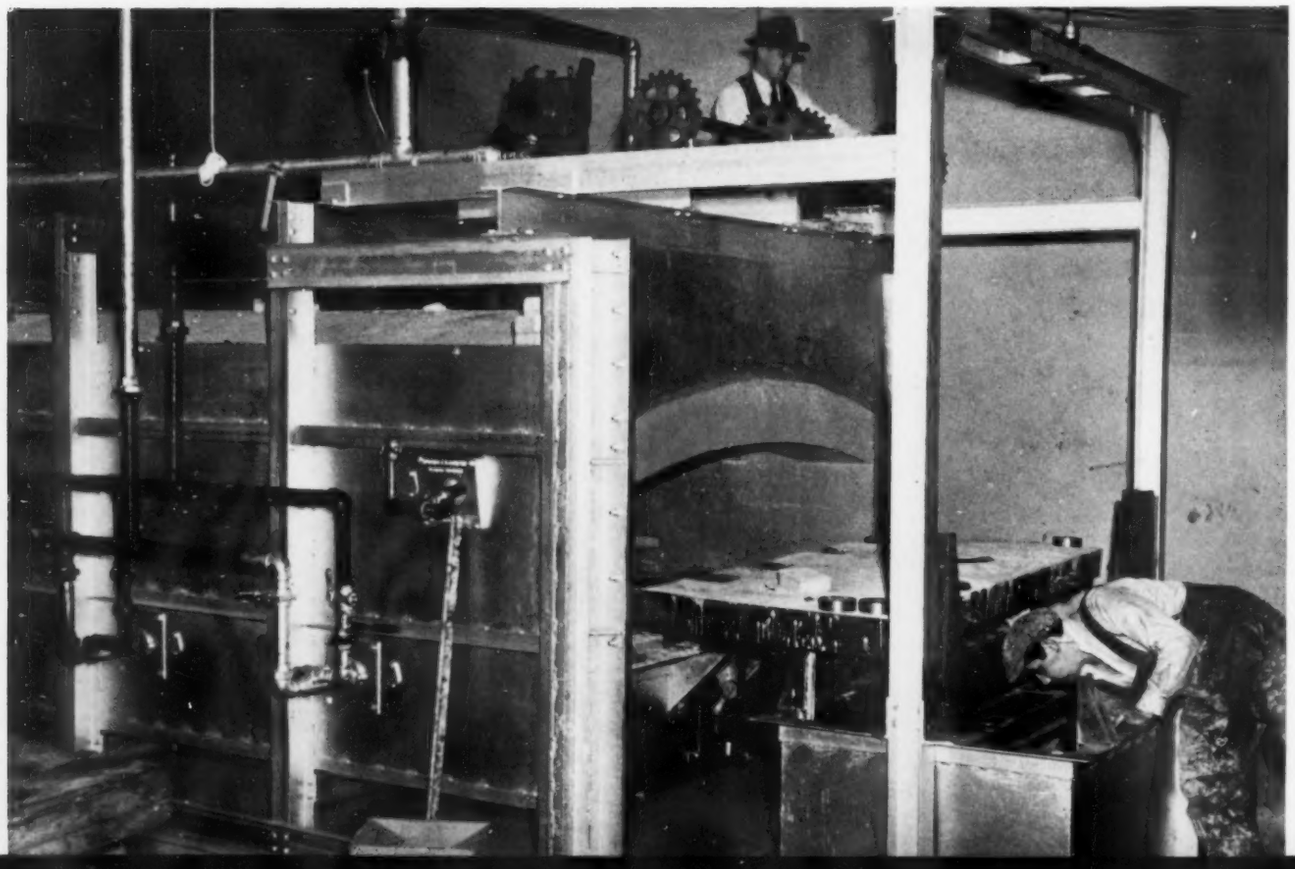
ammunition plant. To this building an additional story has been built for the toolroom and a new wing has been added to house two modern continuous annealing furnaces. Both these furnaces are gas-fired; one is used for the low temperature final anneal and the other for the high temperature anneals.

New hydraulic presses have been acquired for the production of artillery shell cases which at present consist principally of the 18 and 25 lb. sizes. The cases are given six draws with annealing and pickling operations following the first five. Pickling is now done by hand in batch-type wooden tanks. After being dipped in the acid and in a rinsing tank, the cases are dried in sawdust and blown out by hand, using an air hose. Mechanical handling methods are soon to be installed.

After drawing, the cases are indented and

The heading of artillery cartridge cases is done in this 1600-ton hydraulic press. After the head has been formed in the die, the stripper is swung into place and a second stroke releases the work

Modernization of the Dominion Arsenal is under way as exemplified by this conveyor type furnace now under construction. This unit is gas fired and will be used to anneal artillery cartridge cases between draws



ABOVE Inspection is all important where the precision of the product is a matter of life or death. This group is at work on the artillery shell primer and uses limit gages for a 100 per cent check-up of all dimensions

BELOW This turret lathe is one of the many new machines installed in Dominion Arsenal's modern toolroom. Production equipment like this is used because of the large number of punches and dies needed for shell work

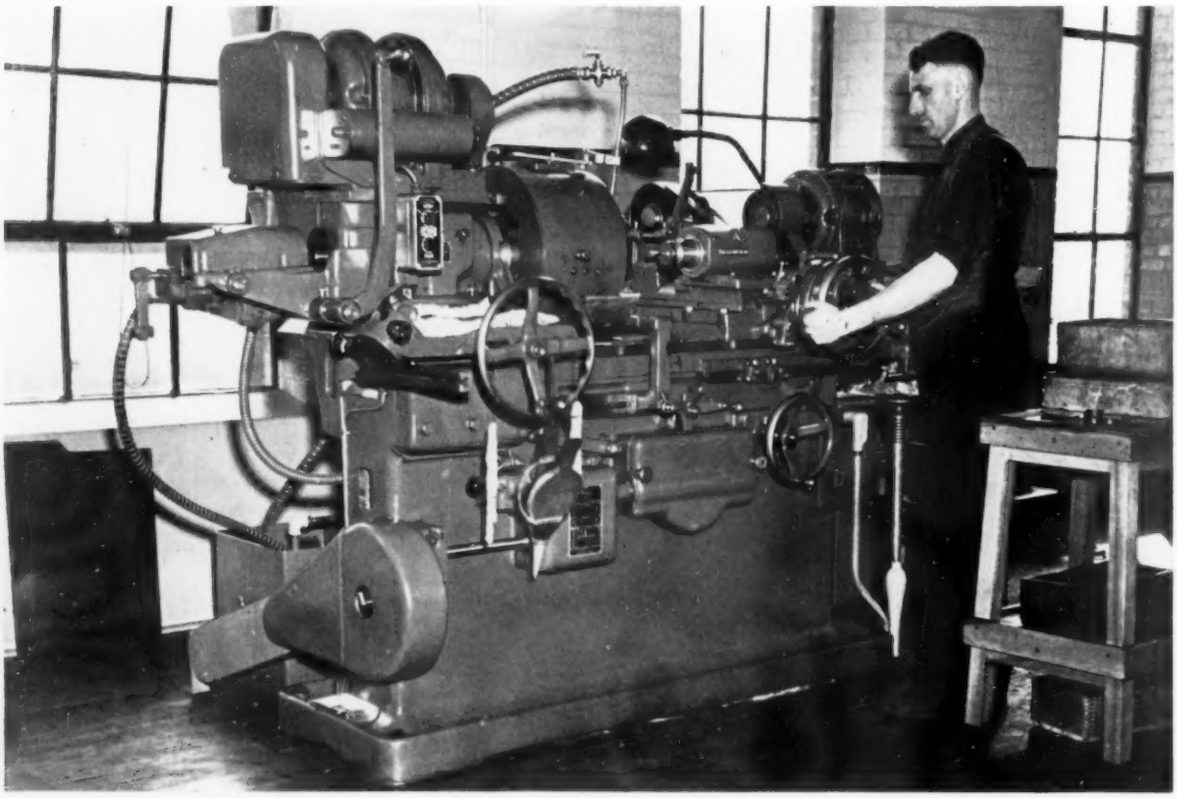
headed. These steps are also performed in heavy hydraulic presses. The primer seat is machined in a standard turret lathe which cuts the thread and takes a facing cut on the base. The cases are then trimmed to length on an arbor prior to the final low temperature anneal.

Inspection of ammunition is not done at the manufacturing arsenal but at Ordnance headquarters. However, process inspection is rigid because of the close limits demanded in ammunition of this kind. The arsenal exerts close shop control including frequent preliminary inspections to insure that these standards are met.

A walk through Dominion Arsenal's modern toolroom brings to light nameplates bearing the names of most prominent manufacturers in the United States with a few British and Canadian made machines. Standard types are used throughout. In its position on the third floor of the new building the toolroom has plenty of air, light and working space. The grinding machines are segregated in a glass-inclosed space to keep the grit away from the other machines, thus protecting their precision.

The chief distinction between this and the usual toolroom is the large percentage of its work which is done on a quantity production basis. Where cartridges and cases are made in millions, punches and dies must be made in hundreds. Hence it is essential to maintain toolroom standards of accuracy on what amounts to mass production manufacture. The high quality of the equipment installed greatly facilitates this objective.

The rejuvenation of the Dominion Arsenal and its fifty-fold step-up to mass production operation is only a single instance of Canada's contribution to the current war. In a few months certain railroad shops will have been converted into a modern munitions plant. The scope of operations at Ordnance Headquarters is now being enlarged. Meanwhile the old Dominion Arsenal fills immediate needs by turning out millions of cartridges for the defense of the Empire.



For precision work on cartridge dies, this modern internal grinding machine has been installed in the Arsenal toolroom. This machine is said to be the first of its kind to be used in Canada's program for stepping up munitions output

AMERICAN MACHINIST REFERENCE BOOK SHEET

TIME-DATA SHEET NO. 25

Sensitive Drill Press Operations—I

PART:

Cast iron, malleable iron, cold rolled steel, hot rolled steel, cast steel, brass, bronze, copper alloys, fiber, micarta, asbestos, slate and marble materials.

OPERATION:

Drill, tap, redrill, counterbore, countersink, burr and ream castings and other raw material.

WORK STATION:

Nos. 2 and 3 sensitive drill presses in the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Company.

CLASSIFICATION OF PARTS:

Very small part	0 to 0.50 lb.
Small part	0.51 to 5.00 lb.
Medium part	5.01 to 20.00 lb.
Large part	20.01 to 45.00 lb.

ALLOWED TIME FOR SET-UP:

Standard Hours = $A_1 + B_1 + 0.0037C_1 + 0.0153D_1 + E_1 + 0.0173F_1 + 0.0275G_1 + 0.0093H_1 + 0.0224J_1$.

Where: A_1 = 0.244 hr. for a No. 2 machine.
A_1 = 0.282 hr. for a No. 3 machine.
B_1 = 0.030 hr. for each No. 2 spindle drilling, reaming, counterboring or countersinking.
B_1 = 0.037 hr. for each No. 3 spindle drilling, reaming, counterboring or countersinking.
C_1 = Number of coolant lines used.
D_1 = Number of jigs or vises used.
E_1 = 0.040 hr. for each No. 2 spindle tapping.
E_1 = 0.047 hr. for each No. 3 spindle tapping.
F_1 = Number of tapping collars put on and taken off.
G_1 = Number of speed reducing pulleys put on and removed.
H_1 = Number of stops set for blind holes.
J_1 = Number of times steel guide blocks are put on and removed.

ALLOWED TIME FOR EACH PIECE:

Each piece time is found by taking the sum of the necessary operations coming under one of the headings in the following tabulations. The regular formula expression has been omitted for simplicity. References are made to the following tables in determining each-piece allowances:

Table No. 1 — Time to clean jig.
Table No. 2 — Time to drill brass.
Table No. 3 — Time to drill cast iron, malleable iron, copper or bronze.
Table No. 4 — Time to drill cold-rolled or hot-rolled steel.
Table No. 5 — Time to drill cast steel or axle steel.
Table No. 6 — Time to tap brass, cast iron, copper or annealed steel.
Table No. 7 — Time to tap bronze, malleable iron, cold-rolled steel or cast steel.
Table No. 8 — Time to drill and tap brass, cast iron, copper or annealed steel.
Table No. 9 — Time to drill and tap bronze, malleable iron, cold rolled steel or cast steel.
Table No. 10 — Time to ream metal.
Table No. 11 — Miscellaneous values.
Table No. 12 — Drill time per inch for various materials.

ALLOWED TIME FOR EACH PIECE IN JIG:

When a jig holding more than one piece is used, allow the constant for the first piece and 0.0002 hr. for each additional piece. The sum of the time values for those operations which are performed only once for all the pieces must be divided by the total number of pieces in the jig.

Allowance Symbol	*Size of Part*			
	Very Small	*Small*	*Medium*	*Large*
Constant	0.0019	0.0028	0.0051	0.0085
M_1	0.0013	0.0013	0.0018	0.0022
N_1	0.0011	0.0011	0.0014	0.0016
K_2	0.0003	0.0003	0.0003	0.0003
J_2	0.0002	0.0002	0.0002	0.0002
T_1	0.0005	0.0005	0.0011	0.0014
$1/R_1$	Table 1	Table 1	Table 1	Table 1
U_1	0.0007	0.0007	0.0016	0.0023
V_1	0.0018	0.0018	0.0018	0.0018
W_1	0.0023	0.0023	0.0023	0.0023
X_1	0.0038	0.0038	0.0038	0.0038
Y_1	0.0048	0.0048	0.0048	0.0048
Z_1	0.0054	0.0054	0.0054	0.0054
A_2	0.0013	0.0013	0.0013	0.0013
B_2	0.0019	0.0019	0.0019	0.0019
C_2	0.0008	0.0008	0.0008	0.0008
D_2	0.0030	0.0030	0.0030	0.0030
E_2	0.0020	0.0020	0.0020	0.0020
F_2	0.0010	0.0010	0.0010	0.0010
G_2	0.0008	0.0008	0.0008	0.0008
H_2	0.0047	0.0047	0.0047	0.0047

(Add machining time allowances from Tables 2 to 12, inclusive.)

Where: Constant = Allowance for handling time.
M_1 = Number of moves to spindle, or from spindle to spindle.
N_1 = Number of moves from hole to hole.
K_2 = Number of holes tapped.
J_2 = Number of holes countersunk or burred.
T_1 = Number of times jig is turned part way over.
R_1 = Number of pieces drilled per cleaning of jig.
U_1 = Number of times jig is turned over completely.

(Continued on Time-Data Sheet No. 26)

Note: The term "allowed time" used in these and following data represents the time required by any worker to perform a given unit of work, using average skill, showing average effort, under average conditions, with average consistency, allowing for fatigue, personal needs and unavoidable delays. *It is the time within which the worker is expected to perform that work.* All times are given in decimal hours. Accurate conversions to minutes and seconds can be made by means of the following formulas: Decimal hours × 60 = decimal minutes; decimal hours × 3600 = decimal seconds. The data given represents standards developed for use at East Pittsburgh Works of Westinghouse Electric & Manufacturing Company for conditions of work existing in that plant. Each allowance should be checked in the light of local conditions before being applied in any other plant.

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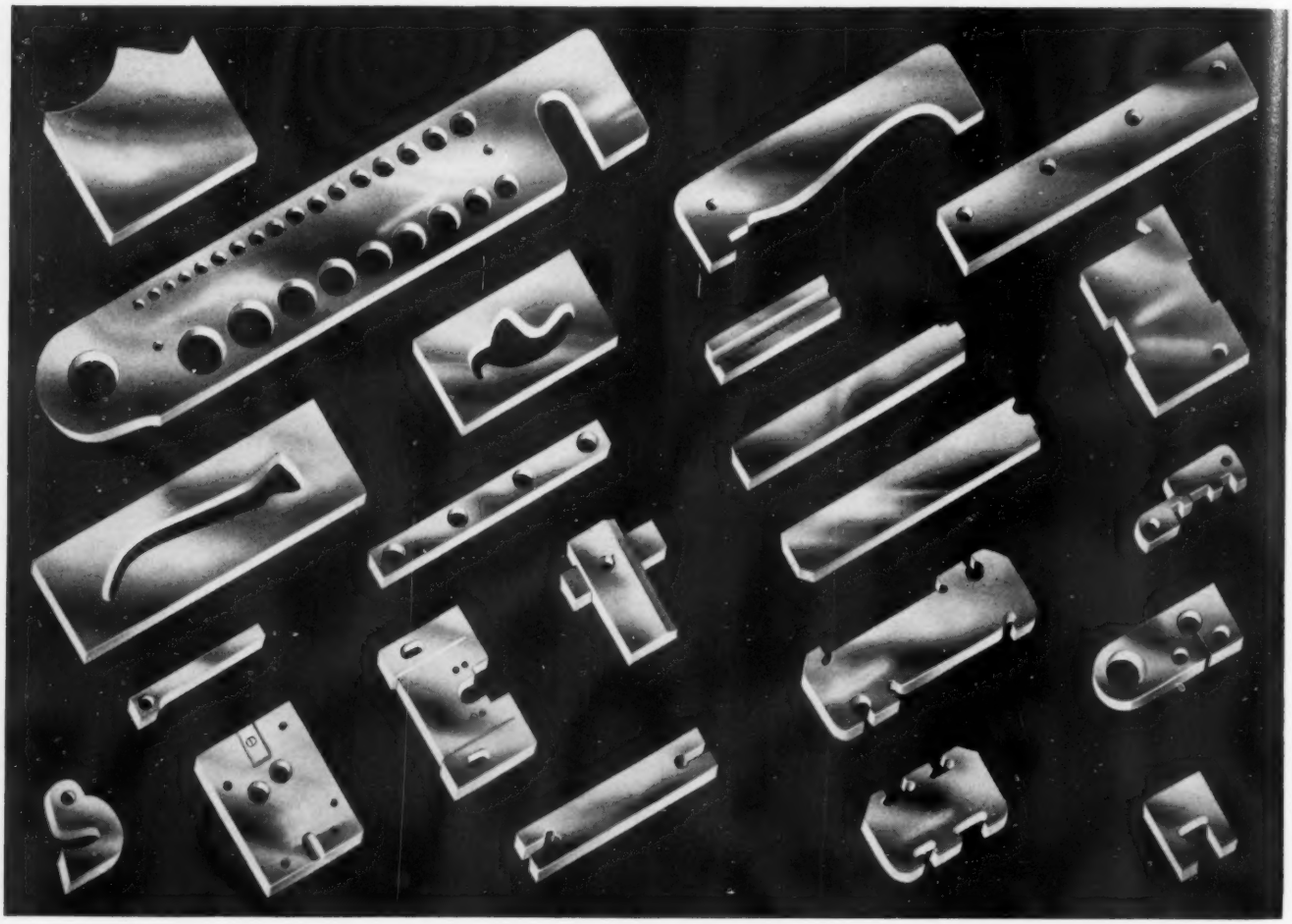

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TIME-DATA SHEET NO. 26

Sensitive Drill Press Operations—II

(Continued from Time-Data Sheet No. 25)

V_1 = Number of short locating screws tightened and released.
W_1 = Number of pairs of short locating screws tightened and released.
X_1 = Number of long locating screws tightened and and released.
Y_1 = Number of pairs of long locating screws tightened and released.
Z_1 = Number of locating screws tightened and released with a wrench.
A_2 = Number of thumb screws or wing nuts tightened and released.
B_2 = Number of hexagonal or square nuts tightened and released with open end wrench.
C_2 = Number of times jig cover is opened and closed when hinged.
D_2 = Number of times jig cover is opened and closed when not hinged.
E_2 = Number of clamps put on jig.
F_2 = Number of bushings used.
G_2 = Number of drift pins used.
H_2 = Number of locating pins used.

ALLOWED TIME FOR EACH PIECE IN VISE:

When more than one piece is put in a vise, allow the constant for the first piece and 0.0002 hr. for each additional piece. The sum of the times for those operations which are performed only once for all the pieces must be divided by the total number of pieces in the vise.

Allowance	*Size of Part*			
Symbol	*Very Small*	*Small*	*Medium*	*Large*
Constant	0.0014	0.0019	0.0038	0.0064
M_1	0.0013	0.0013	0.0018	0.0022
N_1	0.0011	0.0011	0.0014	0.0016
K_2	0.0003	0.0003	0.0003	0.0003
J_2	0.0002	0.0002	0.0002	0.0002
L_1	0.0008	0.0008	0.0022	0.0034
$1/R_1$	0.0020	0.0020	0.0020	0.0020
P_1	0.0010	0.0010	0.0022	0.0040
Q_1	0.0044	0.0044	0.0044	0.0044
S_1	0.0040	0.0040	0.0040	0.0040

(Add machining time allowances from Tables 2 to 12, inclusive.)

Where: Constant = Allowance for handling time.
M_1 = Number of moves to spindle, or from spindle to spindle.
N_1 = Number of moves from hole to hole.
K_2 = Number of holes tapped.
J_2 = Number of holes countersunk or burred.
L_1 = Number of times part is turned over in vise.
R_1 = Number of pieces drilled per cleaning of vise.
P_1 = Number of times vise is tightened and released by hand.
Q_1 = Number of times vise is tightened and released with rawhide mallet.
S_1 = Number of times part is lined up with level or square.

ALLOWED TIME FOR EACH PIECE ON TABLE:

Allowance	*Size of Part*			
Symbol	*Very Small*	*Small*	*Medium*	*Large*
Constant	0.0014	0.0019	0.0038	0.0064
M_1	0.0013	0.0013	0.0018	0.0022
N_1	0.0011	0.0011	0.0014	0.0016
K_2	0.0003	0.0003	0.0003	0.0003
J_2	0.0002	0.0002	0.0002	0.0002
L_1	0.0005	0.0005	0.0010	0.0020

(Add machining time allowances from Tables 2 to 12, inclusive.)

Where: Constant = Allowance for handling time.
M_1 = Number of moves to spindle, or from spindle to spindle.
N_1 = Number of moves from hole to hole.
K_2 = Number of holes tapped.
J_2 = Number of holes countersunk or burred.
L_1 = Number of times part is turned over on table.

Table No. 1—Clean Jig

Size of Jig:	*Small*	*Medium*	*Large*
Clean with brush	0.0020	0.0028	0.0035
Turn jig over to clean	0.0014	0.0022	0.0029
Clean with air hose	0.0014	0.0014	0.0020

APPLICATION:

This formula applies to all machining performed on Nos. 2 and 3 sensitive drill presses under conditions existing on date this formula was made effective.

ANALYSIS:

Tools:

The operator will use drills, reamers, taps, wrenches, pliers, screw drivers, and plug and thread gages. All cutting tools, jigs and fixtures, and gages, should be kept in the toolroom when not in use. There they will be sharpened, if cutting tools, and repaired. No time has been allowed the operator for sharpening his own tools.

Material Handling:

Material should be handled to and from the machine by a laborer. It should be placed as close to the machine as possible, but in such a position that it will not interfere with the movements of the operator.

Inspection:

Time is allowed in the set up for taking the first piece to the inspector and for going to the inspector's bench after he has inspected the piece. The operator is not supposed to wait for the inspector, nor stand around while the inspection is made.

Locating Screws:

A short locating screw is one which is moved ¼ in. or less, while a long locating screw is one that is moved more than ¼ in.

Job Assignment to Machines:

No definite rule can be established to determine whether a job will go on a No. 2 or a No. 3 drill press. This depends on the size of the part, the kind of material to be drilled, and the size of the holes to be drilled or tapped. The time study man should use his own judgment for each individual job.

Power Feeds:

Some No. 3 drill presses are equipped with a power feed. An investigation in the shop has revealed that these machines are in the minority. All data is established on the basis that hand feed will be used. It is as quick as power feed.

(Continued on Time-Data Sheet No. 27)

DEPENDABLY ACCURATE!

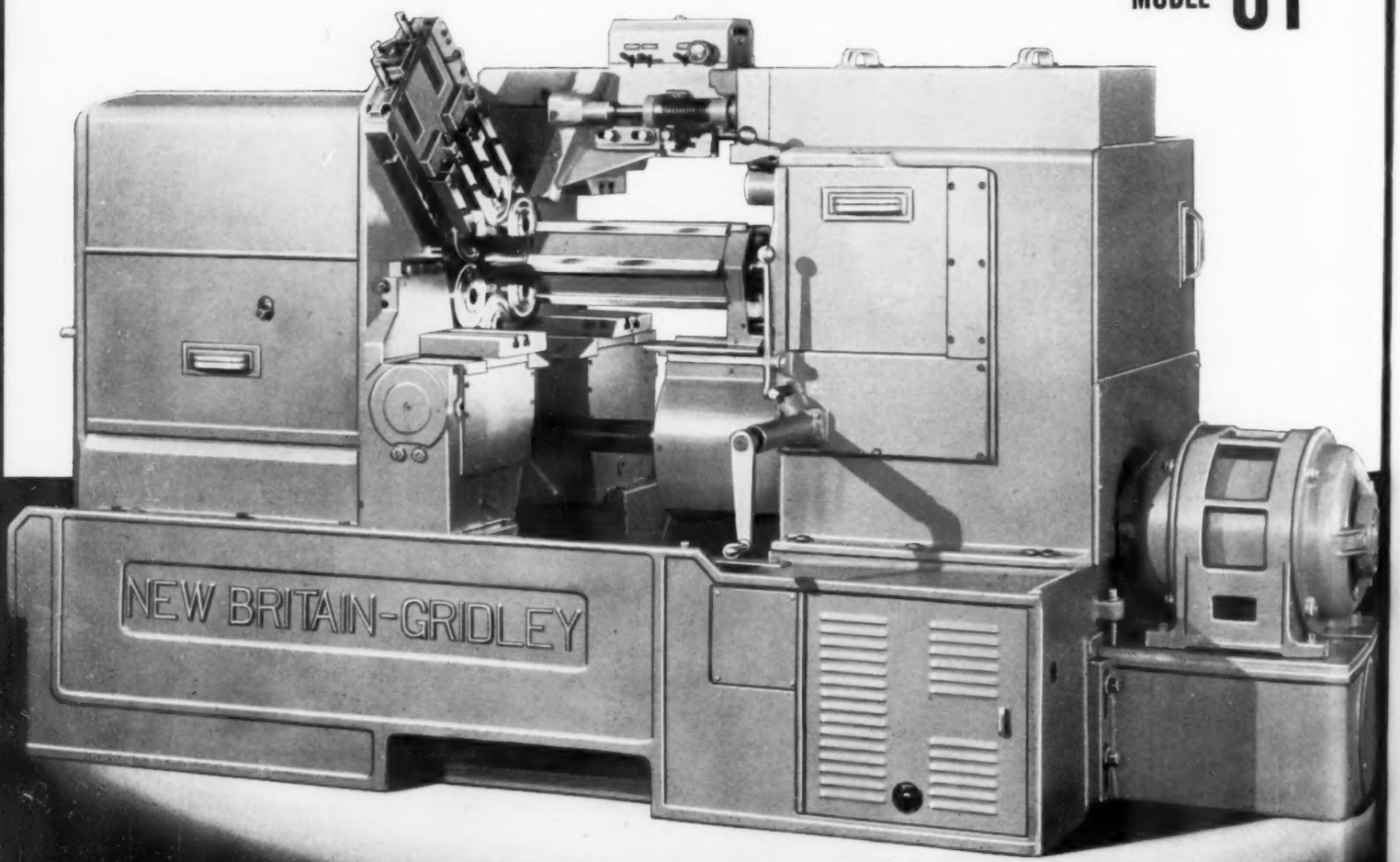
NEW BRITAIN'S complete line of 6 Spindle Automatic Screw Machines for the production of fuse bodies and components, bullet cores, small projectiles and other related parts, incorporate Exclusive Features eliminating wear at all vital points.

Automatic Spindle Carrier Lifting and Clamping Forming Slides mounted on Circular Studs with specially smooth finished bearing surfaces, and many other features are essential to maintain continuous accurate production without frequent adjustment and overhaul.

NEW BRITAIN-GRIDLEY

MACHINE DIVISION • THE NEW BRITAIN MACHINE CO.
NEW BRITAIN, CONN.

MODEL 61



A complete line of Screw Machines — Four and Six Spindles to 2¼" Capacity
Also a complete line of Chuckers — Four, Six and Eight Spindles to 10¼" Capacity

How Much Sabotage?

AN EXPLOSION occurs in a powder-making plant. Without waiting for an investigation, the newspapers immediately yell "Sabotage!" A fire starts on a battleship under construction. The newspapers again present it in a sensational light and hint at dark doings. Any explosion, fire or accident of any kind in any factory with a defense contract raises the suspicion that something sinister is back of it.

We went to Washington to get the facts. They were given us by what the columnists like to call "unimpeachable authority." And they are so totally different from the general public impression that we feel it a duty to make a report on them.

Sabotage is not rampant in the United States. Known cases of it are surprisingly few. It is under better control by the proper governmental agencies than anyone thinks.

To be sure, fires and explosions are happening daily in this country, but that is to be expected when industrial activities are at an abnormally high rate. Thousands of "green" men are at work, large numbers of supervisors have just been lifted to new and responsible jobs. A considerable segment of our industrial organization hasn't yet got into the swing of doing things with the greatest efficiency.

Oh, yes, about the big Kenville, N. J., powder plant explosion. Our lips are sealed by a pledge of confidence, but we were presented with overwhelming evidence that sabotage was not involved. The "big" fire on the battleship *South Dakota* was a $50 blaze caused by a defective piece of equipment used by a workman. And so it goes.

Don't get us wrong. Everything isn't fine. Plenty of people are ready at the slightest opportunity to do mischief in connection with the defense program, particularly if it will delay help to Britain. Some obvious acts of sabotage have been turned up and will continue to be committed. Our vigilance should not be relaxed; instead it should be redoubled.

Nevertheless, an important issue is at stake. If we see hobgoblins and disguised Germans and Japanese lurking behind every fire, explosion and industrial accident in this country from now on, we will be in for a fine case of jitters. From the standpoint of our potential enemies, nothing could be sweeter. An ideal way to retard our armament program is to affect adversely the morale of industrial workers, thereby causing production to fall behind schedule.

After all, the main point is that a scare complex is not justified by the facts. Our plants are still the safest places to work in the world. It is common knowledge that more accidents happen at home than in the factory. On the basis of all available evidence, U. S. industry will continue to be the safest shelter for American workmen during their waking hours.

Whatever we do, let's not be stampeded into an unjustifiable fear of the extent of subversive activities aimed at crippling our armament production. Nothing could please Germany better than to have Americans unwittingly loose upon themselves the psychology of terror which has served German purposes so admirably in other parts of the world.

Burnham Finney

GAGING BUSINESS

Plants expand as machine tool demand grows. British order machines outside machine tool industry. Forty destroyers placed by Navy. Todd to build 60 cargo vessels for British

Machine Tools—Defense orders for machine tools are piling up and the British demand is getting hotter. If the magnitude of the defense program continues to grow, the volume of machine tool business yet to be placed is tremendous. As a result of this pressure and of Mr. Knudsen's appeal to do "the impossible," machine tool builders are surveying ways and means of stepping up operations further. Plant expansions of considerable size are getting under way. Three companies will provide new facilities, over and above those already built the past year, under terms of the so-called bankable contract with the federal government. Announcements of other factory enlargements are anticipated soon.

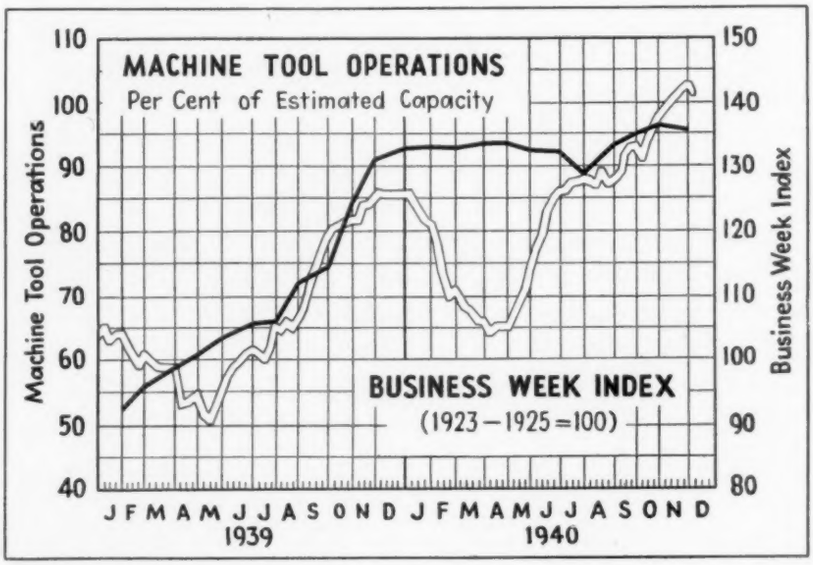
Since the war began machine tool companies are estimated to have spent over $50,000,000 for new equipment and plant additions. The industry is unanimously of the opinion that it could do a much better job of planning production ahead if Washington could provide a blueprint of exactly what the load will be. Thus far Washington has been unable to do this. Efforts are being made to locate idle machine tools in existing plants around the country and put them to work on defense sub-contracts. In Kansas City alone a survey just completed shows enough idle machine tools to equal in number the largest machine tool plant in the country. Railroad shops are said to have many machine tools which they willingly would employ on sub-contracts. British machine tool orders are not being confined to the industry itself, but are being placed with outside companies, including a can maker. The British Purchasing Commission is scouring the land to find companies with which to contract such orders. In such cases machine tools are of older design, including automatic and hand screw machines. Despite the risk of ship sinkings and of plant bombings, most of the U. S. machine tools bought by the British are still being sent to England. Good used machine tools are scarce and are bringing abnormally high prices, which in certain instances surpass the original cost of the machine.

Munitions—Designs are reported to have been frozen on most important armament items. Thus the main job now is to let contracts and push production. The munitions procurement program is believed to be proceeding at a fairly satisfactory rate, in view of the admitted time it takes to tool up plants for manufacture of unfamiliar products. In some cases companies are ahead of shedule. The Navy will erect an ordnance plant at Detroit to cost $12,000,000 to be operated on lease by a private contractor. British ordnance business to be awarded in this country totals $1,700,000,000. Final contracts will not be signed until after legislation on the President's arms lending scheme is passed.

Shipbuilding—Newest development is a surprise award of 40 more destroyers and money to expand facilities to build them at total expense of $261,684,875. Bethlehem Steel will construct four destroyers at Quincy, Mass., three at Staten Island, seven at San Francisco and six at San Pedro, Calif. Bethlehem will spend $4,250,000 for additional facilities at these yards. Bath Iron Works will build six destroyers and Federal Shipbuilding a like number. Seattle-Tacoma Shipbuilding Co., was awarded five destroyers. The Boston navy yard will build four, Philadelphia two, Norfolk two and Charleston two. The British will spend $100,000,000 for 60 cargo vessels to be constructed in the United States by the Todd Shipbuilding Corp.

Aircraft—The task of getting new fighting planes into production, of expanding plants and of training huge numbers of unskilled men has kept plane output from advancing. Shortages of certain parts also have been a troublesome factor. Assemblies, now close to 750 a month, are no better than they were a few months ago, but increased production is looked for shortly.

Allison is now turning out over 350 engines a month and soon will pass the 400 mark. Studebaker and Buick are getting nearer the time when they will formally begin preparations to build the Wright and Pratt & Whitney engines, respectively, under license agreements. Consolidated Aircraft will enlarge its plant at a cost of $14,446,929 to be financed by the Defense Plant Corp., an R.F.C. Agency. Liberty Aircraft will increase its plant for engine manufacture at Farmingdale, L. I., the government providing $1,088,000 for the project. Allison has received an order from the War Department for airplane engines totaling $69,722,625.



Capacity Increases—*The November operating activity of the machine tool industry, measured in terms of payroll hours, is 95.4 per cent. This represents an increase of 3 per cent over October, or an accumulated increase of 54.9 per cent since September, 1939*

AMORTIZATION DEADLINE

WASHINGTON — Manufacturers who have plant expansions underway and who hope to amortize it over the five year period under the new tax law must obtain "certificates of necessity" not later than February 5. It is expected that the government will be so swamped with last-minute applications. Because of this, applications filed later than January 7 may not be acted upon. So far, it is believed, hardly more than one-fourth of those who will want certificates have applied.

Canada's War Orders Hit Billion Mark; Make 130 Planes Monthly

MONTREAL—The total amount of war orders placed by the Canadian and British governments up to Nov. 27, 1940 was $1,000,000,000, according to the chief cost accountant of the Canadian Department of Munitions and Supply. Previously, the amount of war orders reported by the Department was $500,000,000, indicating that only half of the orders placed had been reported.

At present Canadian plane production is about 130 machines monthly, including trainers, fighters, bombers. Of the output most are trainers, but after the first of the year the proportion of fighters and bombers is expected to increase. A new $3,000,000 plant to be built by the government in western Ontario is scheduled to be managed by Fleet Aircraft. After much bickering between the government and the National Steel Car Corp., the latter's plant, which was recently expanded to the tune of $2,500,000, will be ready to swing into full production of combat planes. The plant had been idle for six months during a squabble with the government.

Contracts have been awarded for the construction of six additional submarine chasers. Two will be built at Midland, Ont., shipyards, and four at the Pacific coast yards. Canada's naval construction program has now involved an expenditure of about $70,000,000.

Recent government contracts are: Aircraft, Canadian Wright, Ltd., Montreal, $15,638; Canadian Vickers, Ltd., Montreal, $59,940; National Steel Car Corp., Ltd., Malton, Ont.; $422,950; and Fleet Aircraft, Ltd., Fort Erie, Ont., $18,819. Machinery, Brunner Corp., Ltd., Toronto, $37,461. Munitions, Defense Industries Ltd., Montreal, $41,300; National Steel Car Corp., Ltd., Montreal, $10,572. Ordnance, Hall Machinery, Sherbrooke, Que., $46,675.

Knudsen Asks Machine Tool People "To Do the Impossible" Because of Urgency of Situation

WASHINGTON — Defense Commissioner William S. Knudsen has asked machine tool builders "to do the impossible" in view of "the terrible urgency of the situation" in a letter mailed Dec. 9 which said, in part:

"It is not your fault that Army and Navy requirements weren't known far enough in advance to prevent the dumping of millions of dollars worth of orders on the industry in a very short time. The changes in the program week by week necessitated by changed conditions in Europe make it impossible to figure machine tool requirements very far in advance. But the fact remains that practically all of you are quoting from six to twelve months' delivery. This delivery must be speeded up.

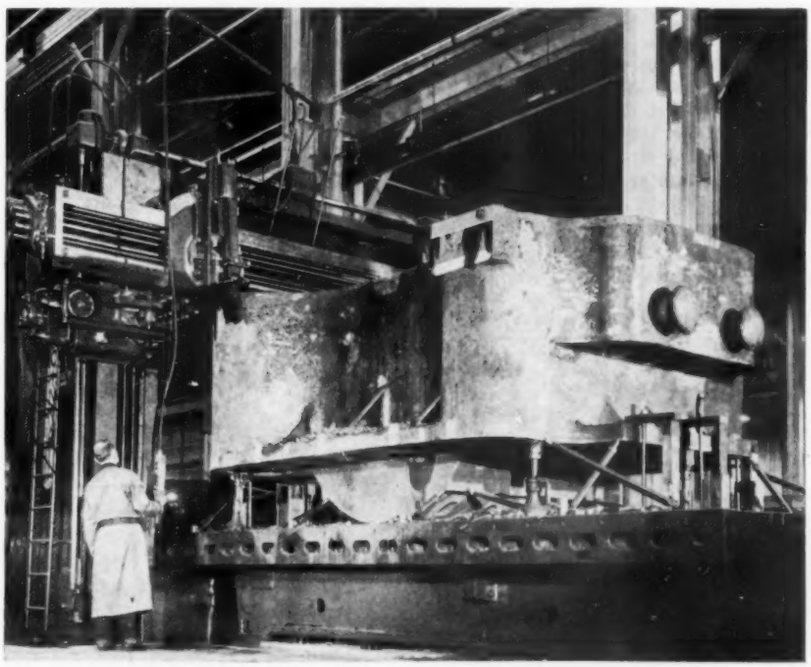
"All of you have made large plant expansions, many of you are running three and two shifts, many are subcontracting some parts, sub-assemblies and whole machines. But not enough of you are doing this. I realize the difficulties of sub-contracting such accurate tools as yours, but if some manufacturers can do this, more can.

"If you could see, as I do, from the inside, the terrible urgency of the situation, you would agree with me that I am not asking too much in requesting you to speed up delivery and increase the production of machine tools during 1941. Let's forget everything except the welfare of our country. The industry as a whole has done practically the impossible in trebling its rate of output in the last two years. I am appealing to you to do the impossible again."

In another letter to machine tool employees, to be posted in machine tool plants, Mr. Knudsen said:

"Do you realize that you are as important to your country today as the soldiers in the Army and the sailors in the Navy? Even more so, because they are helpless without munitions. Machine tools are the most essential item in the defense program, and your job is to build them. They are needed in almost unheard-of quantities for production of airplanes, anti-aircraft guns, torpedo-boat destroyers, tanks—all kinds of munitions.

"Nothing is more vital to your country's welfare just now than to hasten the supplying of these desperately needed machine tools. If you could see, as I do, from the inside the terrible urgency of the situation, you would understand why the Defense Commission is making this appeal to you to put everything you have, without stint, into your job. Only by the cooperation of everybody in this national emergency can the defense task be done in time."



Giant Planers—*At the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, huge castings are machined on giant double-side planers. The casting on the planer (above) is the bed for an H-P-M Fastraverse press of 5000-tons pressure. It weighs 142,000 lbs.*

U. S. SHIPBUILDING SOARS TO RECORD HIGH

Metal-working industry to receive over $3,080,000,000 in the next few years from U. S. shipbuilding business alone. U. S. Naval and Maritime Commission contracts are near $5,000,000,000 mark

By RICHARD K. LA BAN

WASHINGTON — Contracts awarded U. S. Naval ship construction to date total over $3,800,000,000. The remaining portion of the $7,700,000,000 naval ship construction and alteration program will be utilized for armor, armament and equipment, to be contracted for as the ships approach completion.

Meanwhile great progress has been made in expediting contracts for new ships. In addition, shipbuilding time has been materially cut. The 40-month building period for completing cruisers has been shortened as much as one-eighth, submarine construction time has been cut from 30 months to 24 months. Destroyers under construction are being launched three months ahead of schedules. At the present time, new fighting ships are going into service with the navy at the rate of one every 12 days.

Last month building in U. S. ship yards were: 16 aircraft carriers, 15 battleships, 58 cruisers, 185 destroyers, 77 submarines, and many smaller vessels. In all 392 new fighting ships, approximately 2,100,000 displacement tons, were on the way for the U. S. Navy.

New Merchant Marine

But a Navy is shorebound without a merchant marine, which brings it food, supplies, oil. In U. S. shipyards last month this lifeline, a brand new merchant marine, was also building. On the ways were 182 cargo ships with a total gross tonnage of 1,504,655.

At present every available U. S. way (approximately 100) capable of building a ship of 300 ft. or over is occupied. Private yards have experienced an approximate rise of 280 per cent in commercial tonnage, more than 600 per cent increase in Naval tonnage since Jan. 1940. As of Nov. 1, the approximate value of unfinished shipbuilding business in private seaboard yards was $3,065,000,000. This represents an increase of approximately 368 per cent since Jan. 1, 1940, and an increase of 1,269 per cent since Jan. 1, 1938.

Of all American industries, shipbuilding knows the worst experience. Dependent on the Navy and (for most cargo vessels) on government subsidy, it becomes fat or lean in direct proportion to Administration policy. A dying merchant marine was revived in the World War of 1918 when the "bridge of ships" frenzy caused a three billion dollar handout to the shipbuilding industry for 2,300 vessels. Then, from 1922 to 1928, as the government slowly sold its wartime fleet, the U. S. did not build a single vessel for trans-oceanic trade.

Six years ago the U. S. recognized that prolonged inactivity of the shipbuilding industry might result in eventual disaster and decay of property. In 1935 the U. S. began to divide contracts for naval tonnage equally between government Navy yards and private builders. Another hypodermic, the U. S. Maritime Commission, was created in 1936 to guide a government subsidy of a ten year program to replace a moribund U. S. merchant fleet. In 1937 the Commission was well started on its program to provide 50 ships a year for ten years. So far (Nov. 1) construction has begun on 179 vessels of which 72 have been launched and 51 are in service. Besides the 128 now on order contracts for 321 will be let in the next five years. Program's total cost: $1,250,000,000.

Of these two building programs, the colossal Navy $7,700,000,000 upsurge and the Maritime's catalytic $1,250,000,000 the U. S. metal-working industry is scheduled to receive more than 40 per cent of the amount expended. Manufacturers of castings, forgings, lathes, drilling machines, threading machines, boring mills, shapers, grinders, pneumatic tools, electrical machinery, etc., will get $500,000,000 worth of business in the next ten years from the Maritime Commission's program alone. From the Navy's program, the metal-working industry is scheduled to receive orders in astronomical dollar values. A conservative estimate of the business which will go for all types of machinery in the next seven years: $3,080,000,000.

That shipbuilding for the U. S. Navy is not "peanuts" may be seen from the building schedule of the New York Shipbuilding Corp. In May it was building seven ships (all naval) worth $145,000,000. One of the ships, the 35,000-ton, $62,794,000 battleship "South Dakota" put the New York Shipbuilding Corp. in the odd position of a manufacturer producing a single sales unit worth more than four times as much as its total assets ($12,559,000).

With 330 major combat ships under contract, rapid expansion in the nation's shipbuilding industry has been called for to meet the new and speeded-up schedules. Present shipbuilding yards are being expanded, and new yards are being constructed on the west and gulf coasts. The enacted program for the construction of ship ways and shipyard facilities call for Navy construction totalling $150,000,000.

Under the expanded shipbuilding program, sub-contracting will be more widely spread than ever before. Such items as navigating equipment and engine assemblies will arrive in their completed form, ready for installation. Following this procedure, entire boilers will be delivered, auxiliary machinery will be completed and assembled outside the yard, thus requiring only the actual installation work to be done within the shipbuilding yards themselves. This procedure will free the larger sub-contracting facilities

Value of Shipbuilding

Unfinished Commercial and Naval Business in U. S. Private Seaboard Yards

Compiled by the National Council of American Shipbuilders

Date	Commercial Vessels	Naval Vessels	Total
	Millions of Dollars		
Jan. 1934	$7	$140	$147
" 1935	1	118	119
" 1936	14	165	179
" 1937	50	119	169
" 1938	51	113	164
" 1939	137	255	392
" 1940	267	294	561
Nov. 1940	270	2.795	3,065

Distribution of Ways

Capable of Building Ships 300 Ft. and Over

(As of December, 1940)

	Active	Inactive but capable of repair at nominal expense
North Atlantic ...	53	16
South Atlantic ...	12	4
Gulf Coast	8	8
Pacific Coast	10	9
Great Lakes	17	3
Total	100	40

Compiled by the National Council of American Shipbuilders

DISTRIBUTION OF CONTRACTS

WASHINGTON—Under the expanded defense program, many sections of the nation will participate in the primary contracts for ship construction. A regional breakdown of the $3.800,-000,000 of contracts already awarded shows that the major portion is concentrated in the northeastern section of the U. S. The geographical distribution is as follows:

New England ...	$900,000,000
Middle Atlantic.	1,000,000,000
South Atlantic..	600,000,000
Pacific Coast....	500,000,000
Great Lakes.....	200,000,000
Unassigned	600,000,000

for other defense projects, while the smaller machine shops throughout the nation will participate in building up materials and sub-assemblies necessary to the program.

Skilled Labor Needed

The intense activity in shipbuilding centers has resulted in a sharp rise in shipbuilding employment. The latest figures show 162,000 workers employed directly in the shipyards. As of December, 1939, employment in 33 principal private shipyards reached the 50,000 mark for the first time in two decades, while at Nov. 1, 1940, employment crossed the 70,000 mark. For every employee in the shipyards there is another employed in the plants furnishing materials for ship construction. This brings the total currently employed under the shipbuilding program to more than 300,-000. By August 1941 it is estimated that 1,852,000 workers will be directly and indirectly absorbed by the entire shipbuilding industry.

However, a very real shortage of naval draftsmen, welders, riveters, machinists, is reluctantly admitted by employers who fear that workers may seize this as a basis for higher pay demands. Shipbuilders are now luring students from the marine architectural courses before graduation, for instance, with a salary triple that which degree-holders from the same courses were able to grab a year ago.

Almost all private shipyards have increased the number of apprentices and have established training schools in the yards to increase the supply of available labor. President Roosevelt, who did not agree that a labor shortage existed, barred any increase in the working hours on July 2 until about 2,000,000 unemployed has been absorbed by industry.

The average annual earnings in Navy yards of all employees working 12 months in 1935 were $1,909, in private yards on the Atlantic Coast average annual earnings were $1,500. Similar figures were recorded for 1938. The higher averages in the Navy yards was due to considerably higher hourly earnings and longer weekly hours. Since 1935, however, private shipyards have increased the hourly earnings and weekly hours, granting vacations with pay to some employees, and provided stable employment.

For 1940 a slight rise in annual earnings was recorded for workers in both Navy and private yards. The present demand for labor far exceeds the supply. Wages, hours, and annual earnings soon will experience an abnormal rise. However, the rise will be slow as shipbuilders have labor union contracts calling for present wage rates to be paid for some time. As these contracts expire, higher rates will undoubtedly be paid all over the U. S.

In order to explore ways and means of stabilizing employment in the nation's shipyards, the Labor Division of the National Defense Commission has appointed a Shipbuilding Stabilization Committee, headed by Sidney Hillman, to undertake a detailed investigation of wage rates, working conditions, migration of workers and its effect on production.

U. S. Private Yard Construction

Self-propelled Seagoing Commercial and Naval Tonnage Under Contract 1935-1940

Compiled by the National Council of American Shipbuilders

	No. of vessels	Tons
	1935	
Commercial ...	2	19,022
Naval	33	140,000
Total	35	159,022
	1936	
Commercial ...	16	92,074
Naval	46	182,024
Total	62	274,098
	1937	
Commercial ...	30	189,090
Naval	39	160,930
Total	69	350,020
	1938	
Commercial ...	32	235,250
Naval	36	144,650
Total	68	379,900
	1939	
Commercial ...	59	538,100
Naval	38	209,620
Total	97	747,720
	1940 (Estimate)	
Commercial ...	182	1,504,655
Naval	392	1,300,000
Total	574	2,804,655

Down The Ways—*Goes the 395 ft. C-1 type cargo vessel, the Joseph Lykes. Built by the Federal Shipbuilding and Drydock Co., the ship weighs 6,829 gross tons, was launched Aug. 1940. The ship was built as a part of the U. S. Maritime Commission's program to build 500 ships in ten years at a cost of $1,250,000,000*

Last Year's Machine Tool Products Were Worth Over $300,000,000

WASHINGTON—The value of products for the machine tool industry last year was $218,044,728, plus $125,-630,124 for accessories. Metal-working machinery not elsewhere classified amounted to $98,975,454. The total of all types of machinery was over $580,-000,000, as indicated by a preliminary report from Department of Commerce, Bureau of Census.

A total of $49,956,214 of new machinery of specialized types was manufactured last year for selected industries which included machinery used in cotton-ginning, in the working of glass, cement, incandescent lamps, clay, rubber, stone and leather, in hat and shoe-making. In 1937 these items amounted to $55,706,659, or a decline of about 10 per cent in the two-year period.

MORE ELECTRIC TRUCK SALES

CHICAGO—A total of 249 units of electric trucks and tractors were booked in November, 1940, as compared with the previous high of 193 units recorded in October of this year. Total net value of the chassis only was $827,003 as against the October figure of $653,682.

KNUDSEN ASKS DEFENSE EFFORT ON WAR BASIS

"Total Preparedness for America's Future" stressed by speakers at meeting of National Association of Manufacturers. Industry pledges full support to co-operate in national defense program

NEW YORK—"Total Preparedness for America's Future" was the theme of the Congress of American Industry held under the auspices of the National Association of Manufacturers Dec. 11-13. The defense program and the part which industry will play in it was foremost in the minds of most speakers. The meeting reached a climax at the annual dinner when Defense Commissioner William S. Knudsen pleaded for the national defense effort to be put on a war basis and for industry to end the Friday to Monday "black-out of factory" by operating on Saturdays. He expressed doubt whether the defense job has been adequately sold to the two most important elements, industry and labor, though the public generally is sold.

Plane Production Scaled Down

Mr. Knudsen said that the airplane production schedule, which called for 1,000 units a month by Jan. 1, has had to be scaled down 30 per cent. Most of the heavy combat planes are new models not heretofore in production, and that has slowed down output. Engine companies are behind schedule and need equipment. Guns and machine guns are still in the tooling stage. However, jobs that are wholly on machines will pick up fast when the tools are ready because assembling is the smaller part of the hours per job. The same reasoning applies to powder and its ingredients. Light tanks are being produced at a rate of four a day and medium tanks will be available from six plants by mid-summer.

In round figures, the defense program means: 50,000 airplanes; 130,000 engines; 17,000 heavy guns; 25,000 light guns; 13,000 trench mortars; 33,000,000 shells loaded; 9,200 tanks; 300,000 machine guns and ammunition; 400,000 automatic rifles and ammunition; 1,300,000 regular rifles and ammunition; 380 Navy ships; 200 mercantile ships; 210 camps and cantonments; 40 government factories; and clothing and other equipment for 1,200,000 men. British material placed in the United States at present is included in these totals. Altogether the program will require 18,000,000,000 man-hours.

"Have we done everything we can to utilize existing facilities and offer them to companies having defense contracts?" asked Mr. Knudsen. "Can we subcontract more of our work and spread it so as to make speed and more speed that way? Every manufacturing concern which has a defense contract should be informed of idle facilities in the locality so as to confine the new equipment as far as possible to special machinery. Our machine tool industry is working hard and well on its job. It has set a very good example of speeding up before us and it is about the way other items of defense will have to proceed if we are going to make time."

Speaking on "The Problem of the Supply of Labor," Clifford S. Stilwell, executive vice-president Warner & Swasey Co., pointed out that 18 productive civilians now are needed in support of each man in active military duty, as against two in the first World War. Should the U. S. be called upon to match the productivity of the German war program, the load to be carried by industry in contrast with 1917 is tremendous. Thus modern war is primarily a war of supporting industry.

Mr. Stilwell illustrated the problem of labor by reference to the machine tool industry. From a normal demand of $100,000,000 a year machine tool builders have been confronted with orders of $500,000,000 and with specifications which call for immediate delivery.

The expansion problem has been difficult because no one so far has been able to tell just what types of machines must be produced or in what quantities. If and when the defense program will produce a schedule of its needs in machine tools, that schedule will be accomplished.

The industry in the last twelve months has recruited 40,000 men, thus doubling its personnel. "We were not far advanced in this somewhat explosive transition," said Mr. Stilwell, "before the supply of available skilled mechanics in most industrial communities was well nigh exhausted, and now no longer exists. Despite continued claims of a substantial available supply of such men, these sources are being constantly explored with disappointing success. The problem is one of training either men of no experience or of retraining older men without experience and background in tool building. It is being accomplished."

Short Term Program

Amazing results have been secured from short-term or learner programs of training, asserted Mr. Stilwell. The sources of material for such training are necessarily random. Technical high schools, colleges and engineering schools have been fruitful sources. The procedure in training these people depended first upon the cooperation of older employees in personally sponsoring the individual candidates. The natural aversion of organized labor to this somewhat unlimited introduction of men in a given trade was overcome by having the older employee understand the critical nature of the circumstances. The turnover has been remarkably low.

After two to three months, virtually all of the "learners" at Warner & Swasey have proved satisfactory as machine operators and for bench and assembly operations. A large number have become skilled workers within a

Charles Kettering, vice president, General Motors Corp.; William Knudsen, National Defense Commission; Clifford Stilwell, executive vice president, Warner & Swasey Co.; and Philip D. Reed, chairman of the board, General Electric Co., all spoke at the National Association of Manufacturers' meeting

Export of Machinery During October, 1940

	October 1940	September 1940	October 1939
Electrical Machinery and Apparatus	$10,494,951	$9,688,513	$9,555,739
Power-generating machinery, except automotive and electric	1,895,921	1,588,044	1,125,961
Construction and conveying machinery	2,750,359	2,075,348	1,965,494
Mining, well and pumping machinery	3,491,008	3,220,322	4,448,900
Power-driven metal-working machinery	26,798,995	22,452,289	9,121,340
Other metal-working machinery	811,255	750,880	464,060
Textile machinery	1,219,550	1,024,113	753,869

Metal-Working Machinery

Engine lathes	$1,755,049	$850,509	$546,071
Turret lathes	2,164,490	1,826,706	764,549
Otner lathes	3,027,585	1,204,697	335,440
Vertical boring mills and chucking machines	810,944	845,087	315,315
Thread cutting and automatic screw machines	2,976,694	2,450,812	523,542
Knee and column type milling machines	1,509,884	2,080,354	649,627
Other milling machines	3,407,275	2,601,123	507,721
Gear cutting machines	640,646	629,683	505,383
Vertical drilling machines	312,373	408,458	96,616
Radial drilling machines	460,875	246,406	87,089
Other drilling machines	556,548	739,130	145,239
Planers and shapers	589,046	666,875	192,415
Surface grinding machines	882,574	553,676	279,525
External cylindrical grinding machines	659,388	348,385	430,569
Internal grinding machines	603,766	380,363	458,923
Tool grinding, cutter grinding and universal grinding machines	886,130	617,770	325,388
Other metal-grinding machines and parts	1,607,447	1,217,316	625,358
Sheet and plate metal-working machines and parts	652,374	828,297	487,938
Forging machinery and parts	422,102	948,975	301,243
Rolling mill machinery and parts	368,777	1,100,016	381,931
Molding machines	23,764	32,818	9,833
Other foundry equipment and parts	201,671	126,083	125,484
Other power-driven metal-working machinery and parts	2,263,128	1,731,624	1,025,858
Pneumatic portable tools	110,875	110,244	120,293
Other portable and hand or foot-operated metal-working machines and parts	208,359	191,805	112,208
Chucks for machine tools	73,852	62,345	50,454
Milling cutters, machine-operated threading dies and taps, and similar machine-operated metal cutting tools	136,849	116,555	55,464
Other metal-working machine tools and parts	281,320	269,931	125,641

second period of two to four months. Three such young men now operate a plane on the base of turret lathes. A considerable group of men ranging in age up to 45 and 50 years have shown remarkable ability for certain jobs.

Mr. Stilwell emphasized the difficulty of securing quickly the type of foremen who can deal as successfully with the human problem as with the other factors of production. He said, "A great deal of the trouble of employer and employee relations arises not so much from antagonism to management policy as from failure on the part of the foreman clearly to interpret these policies to the men in line."

If there is any single element of the present German philosophy which might be acceptable in our own scheme of American freedom, remarked Mr. Stilwell, it is that no measure of value can be substituted for work.

Philip D. Reed, chairman of the board General Electric Co., analyzed the economic problems resulting from the war in Europe and the possible means of their solution. He believes that a condition of internal economic health in the post-war future can only result from a carefully planned and projected program participated in by organized labor, by trade and civic organizations throughout the country, and by the government. This program calls for rigid reduction of government expenditures for non-defense purposes.

The Congress of American Industry pledged itself (1) to continue to defend against attack from any source the American concept of freedom, (2) to exert its utmost effort in cooperation with the government to carry out the program of national defense with all possible speed and efficiency, (3) to maintain at the same time, as far as possible, production of goods and services to meet normal needs, (4) to do its full part to prevent or cushion a threatened post-war economic depression by supporting and following practices which will contribute to maintenance of a healthy economic life; and (5) to continue to promote within industry recognition and fulfillment of the economic and social responsibilities which industrial management shares with other groups for the improvement and advancement of the general welfare.

WILL LEASE MACHINE TOOLS

WASHINGTON — Army arsenals want to lease 2,100 machine tools to people who need them for defense work. Lease fee is 12½ per cent of today's estimated value based on 50 per cent of roginal cost if machine is 5–10 years old, 40 per cent if machine is 11–15 years old, and 25 per cent if machine is over 15 years old. Boring mills, large lathes, millers, profilers and planers are included in the list. Anyone interested should get in touch with his district ordnance office.

U.S. Machinery Exports Hit New Record, Metal-Working Increases

WASHINGTON—Exports of machinery from the U. S. during October reached the record value of $43,567,434, surpassing by nearly $2,000,000 the previous high established in December, 1920. All the major machinery classes shared in the gains, but shipments of power-driven metal-working machinery showed the largest increase, rising to the record value of $26,798,995, a 20 per cent increase over September.

October exports of mining, well, and pumping equipment totaled $3,491,008, a gain of 8 per cent over September shipments valued at $3,220,322. A 33 per cent gain was recorded for shipments of construction and conveying equipment, which reached $2,750,359 in October as against $2,075,348 in the preceding month. Power-generating machinery valued at $1,895,921 was shipped from the U. S. in October, an increase of nearly 20 per cent over September exports amounting to $1,588,044.

Willys-Overland Leases Machinery Equipment to Fill Shell Order

TOLEDO — Willys-Overland Motors, Inc., expects to get going on its big shell parts and munitions contract early in April. To fill its order for $8,750,000 of ammunition components the company is now negotiating on a lease of $1,600,000 of machinery to equip its plants for the task. It will get the machine tools from the government under the plan whereby the Defense Plant Corp., a subsidiary of RFC, furnishes equipment for manufacturers. The leasing device merely eliminates the necessity of the company borrowing money for equipment.

PRIORITIES FOR SUB-CONTRACTORS

WASHINGTON — Small manufacturers working on sub-contracts involved in the national defense program are now subject to potential federal priority regulation as a result of an executive order by the president. This action enables the Government at any time to force subcontractors to put aside any private orders or contracts and devote their time to filling orders placed by the Army or the Navy. On Oct. 22 the President had issued an order giving the Priorities Board authority to recommend priorities where necessary among primary contractors. So far the Priorities Board has not invoked priority in any industry. Instead the Board, backed by the reserve authority of the President's first order, has cooperated with trade associations.

INSIDE DETROIT

Auto production likely to be 4,685,000 units during the 1940 calendar year. Relations between auto companies and labor are more amicable; G-M and Chrysler finish negotiations quickly

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Automotive circles anticipate that December output of cars and trucks will be close to the 500,000 mark. While this figure is down slightly from the October and November figures (514,374 and 514,500 respectively), it is sufficient to push the fourth quarter into new high ground for the industry. Auguries for the first quarter of 1941 point to operations stabilized near the present production rate, and the possibility that the new record set in the first 90 days of this year will be surpassed.

Production for the calender year 1940 is thus likely to be 4,685,000 units in round numbers, or 25.5 per cent ahead of 1939. The first eleven months of the year accounted for 4,188,934 cars and trucks, or 28 per cent ahead of the comparable period a year earlier.

Auto-Plane Program

The Automotive Committee for Air Defense has had to mark time somewhat in completing the bomber-parts display at its headquarters in the Graham-Paige plant, Detroit. Most of the delay is attributable to the fact that the bombers selected for the mass-production program are new types, and it is difficult to assemble sample parts and blueprints thereof for shipment to Detroit. Nevertheless, the 40,000 sq.ft. exhibition space is being gradually filled up. Most recent additions have been a stabilizer and part of a fuselage. Local automotive concerns possessing sub-contracts with the aviation industry are cooperating in the educational work.

The Auto Committee has made it clear that its function is comparable to that of the National Defense Commission, namely, make sure that capacity to perform the assigned jobs is available, and that efficient utilization of manufacturing facilities is attained. It will not have the power or responsibility for placing contracts. Contracts for production of parts and sub-assemblies will be placed with automotive companies by the plane makers holding contracts with the government to deliver finished planes.

Companies wishing to figure on aircraft parts are invited to visit the exhibit (a special pass must be obtained) or write the committee describing the type of work and volume of the establishment, the character of equipment installed and the personnel. Next the potential supplier may embark upon experimental studies of the parts he would like to manufacture, and await call from the committee for a more complete appraisal of his plant facilities, or he may immediately seek orders from aircraft manufacturers who may need assistance to expedite contracts now underway.

Three Point Attack

The time schedule for the bomber-procurement program has not been set by the government, but meanwhile the Committee is undertaking a three-point attack on the project:

1. To acquaint as many prospective suppliers as possible with the type of work to be done, so that they can start figuring ways and means. Several hundred companies have already sent representatives to the exhibit, and are now figuring production methods. High officials of Ford and Chrysler have been there several times. A valuable by-product of the exhibition is bringing parts suppliers together with aircraft companies now needing assistance with present contracts. For example, Eureka Vacuum Cleaner, Detroit, obtained a $250,000 contract from Martin for aluminum parts. Neither company had previously suspected that the other needed or wanted its services.

2. To obtain for automotive production men some knowledge of aircraft production problems, and the methods of manufacture worked out in aircraft plants. The committee now has a technical staff consisting of W. F. DeGroat, formerly chief engineer of Barkley-Grow; Charles D. Koch, formerly project engineer of the same company; and W. F. Johnston, for ten years in various capacities with Boeing, including production. The Army Air Corps is also keeping men on hand at the exhibit to explain parts and methods.

3. To survey and list facilities in the automotive field and related industries, so that once the assemblers are ready to go, they will have before them a thorough "blueprint" of the sources of supply at their disposal. It appears that this stage will not be reached until some time in the spring.

PLANE PARTS DELAYED

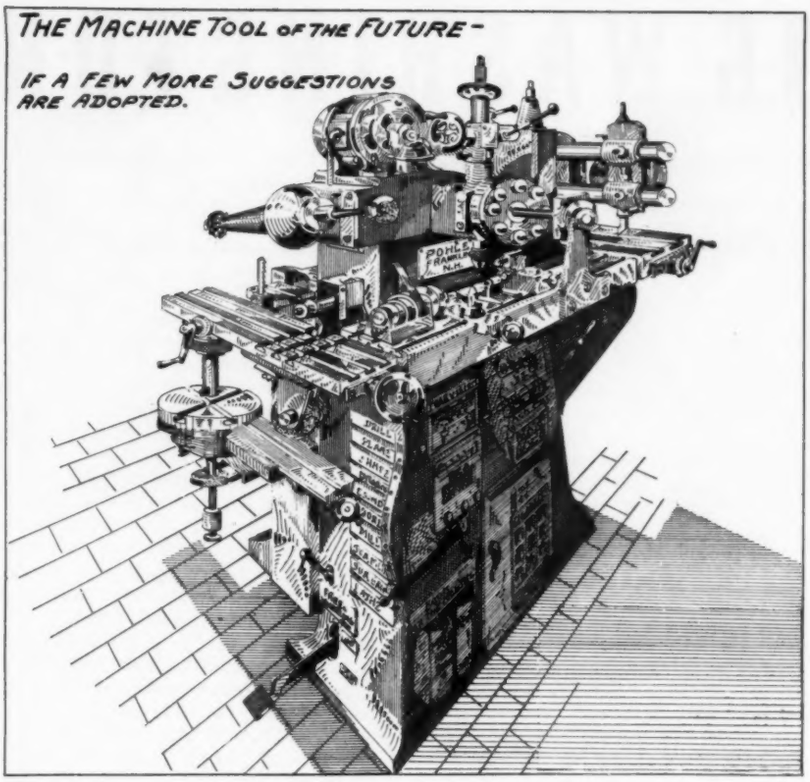
DETROIT—Airplane parts manufacture by automobile companies is a long way off. The letting of contracts alone will likely take four or five months. Many factors have slowed the program. Most automotive parts equipment is not suitable for the new job, and tooling will have to be "from the ground up". Automobile makers will not tackle production of aluminum forged aircraft parts which are regarded as a bottleneck. The job is tricky and they have had no experience at it. Forgings will continue to be furnished by a few companies with the "know-how". Two more big airplane assembly plants will be built, in addition to the two already announced. One may be in Indiana. Army objects to any more munitions factories being put at Detroit.

In sharp contrast to a year ago, auto companies and labor seem able to sit down amiably and reach a quick decision upon revisions of contracts. The General Motors negotiations this spring were settled without violence as contrasted to the bitter tool and die strike the previous summer. Chrysler wound up its negotiations in two weeks, compared to experiencing a slowdown and an eleven weeks shutdown last year. Briggs and Hudson concluded new agreements practically without public notice until they were signed.

Both sides in these negotiations had had previous experience in measuring the motives and fighting powers of the other. For public consumption, and that of the union rank and file, the union demands were skyhigh. Actually, both sides knew just about how far the other would go, also how much face had to be saved on either side.

The Chrysler settlement is noteworthy for three things: (1) the 1939 contract was renewed in full, (2) wage rates were frozen for one year in return for two cents an hour and a $40 Christmas bonus to persons with at least one year's seniority and (3) the company went half way on a union demand that multiple-shift operators be paid for eight hours, and get time off for lunch. Actually the men will now work 7¾ hr. instead of 7½ hr., with one quarter hour for lunch and get eight hours pay.

Union sources claim that the bonus and wage increase will net its members in eleven plants $6,744,000 per year. Other sources figure that the corporation will disburse about $4,500,000 extra. The company pays a Christmas bonus but does not accede to the principle of vacations with



Card—*R. F. Pohle, catalog illustrator, sends this greeting which takes a friendly poke at machine builders who sit up nights thinking of new gadgets to hang on their products*

Japan's Imports Troubled Little By U. S. Export Restrictions

TOKYO—Although Japanese import statistics are no longer released for publication, private records at the principal import organizations indicate that the month-to-month trend of Japanese imports has set new spectacular records during October and November. Little difficulty is apparently experienced in obtaining clearance papers as required under U. S. Export Licensing regulations.

During the past year investments in the machinery and tool industry have reached approximately $120,085,000. Investments in bonds and shares of machinery and machine tool concerns have now reached a total of $714,-987,500, making it the largest single manufacturing industry in point of capitalization. This figure accounts for 8 per cent of all registered corporate capital in Japan.

If and when the U. S. and Japan go to war, many American concerns will have to "write-off" large investments. Americans hold investments in the Japanese government, power plants and in American manufacturing industries in Japan. In the last group alone, which is the smallest of all, total investments amount to some $60,000,000, most of which comes under the heading of machinery and machine tools.

pay, or vacation allowance, as in the General Motors contract. Furthermore, it is understood that the total increase granted the union does not exceed one-half the amount distributed as bonus to employees in good years prior to the union. On the other hand, the union can say that its members are now receiving perhaps the top scale in the industry. And many of the older workers will tell you that their annual incomes used to be higher.

The Briggs contract provides a $40 Christmas bonus to 17,000–18,000 workers and a two-cent-an-hour raise.

These settlements leave the way clear for the UAW-CIO to attempt to organize fully the parts industry, the aircraft-parts plants in the Middle West and on the Pacific Coast and the drive on Ford. The union is silent on its strategy after petitioning Ford for an election and having it refused. Recently the Dearborn handbill ordnance designed to prohibit distribution of union literature at Ford gates was thrown out by the courts. Some time ago Ford issued a statement to show that its workers enjoyed stabilized employment and high annual incomes. The union asserts that rates are well below those of G.M. and Chrysler. With the lid partially off so far as reaching Ford workers is concerned, the battle of the century is in the making.

Discuss Speed-up of Standards for Defense At American Standards Association Meeting

NEW YORK—The annual meeting of the American Standards Association held recently was devoted to speeding-up the framing of standards for items used in the national defense program. Already this year the Association has adopted 73 new industrial standards. During the sessions R. E. Zimmerman, vice-president of U. S. Steel Corp., was elected president of the Association, succeeding Edmund A. Prentis who headed the organization for the past two years, and R. P. Anderson of the American Petroleum Institute was re-elected chairman of the Standards Council which is in charge of all A.S.A. technical work.

Probably the most important standard in the mechanical field to be approved by the A.S.A. in the past year is one on twist drills. Also approved during the year were standards on cast-iron pipes, steel pipe flanges and fittings, and spur gearing.

Retiring president E. A. Prentis, called attention to the fact that the defense program had highlighted almost all standardization work in the mechanical field in the past year. One of the problems of the coming year, he said, would be to speed up procedure on undertakings most urgently needed for defense, including work on screw threads, bolts, nuts and wrench openings, on machine pins, on wire and sheet metal gauges, and on the fit of machine parts.

Representative Hattan W. Sumers, vice-chairman of the Temporary National Economic Committee, asserted at the meeting that a great need exists in preserving a democracy of opportunity for large, medium and small business.

EXTEND EXPORT LICENSES

WASHINGTON—President Roosevelt has applied increased economic pressure against Japan through a proclamation placing iron ore, pig iron, ferro alloys and certain iron and steel manufactures under export license requirements, effective December 30. Although licenses are required to export these articles to most other countries, Japan has been buying increased quantities of these materials from the U. S. since the export ban was put on iron and steel scrap in October and will be hard hit.

WATCHING WASHINGTON

U. S. aid to Britain will be greatly increased. Arms production here seen as undergoing a change of tempo as it is geared for optimum output a year from now. Social legislation interferes

By BLAINE STUBBLEFIELD

WASHINGTON—It is easy to overestimate the immediate effects upon industry of the President's policy of loaning armament to Britain. It is primarily a financial and political rather than a production matter. However, the new policy does not affect the volume of arms produced in this country, but grants credits to Britain, specifies payments in goods rather than in cash. Obvious intent is to erect a guarantee against such a situation as existed after the last war when high tariffs impeded payment of war debts.

The plan will however have a host of incidental effects arising from the fact that the producers of arms for the British will be dealing with the U. S. Government rather than a British purchasing commission. Plenty of manufacturers have felt that however many restrictions are placed around U. S. arms production, there would always be a little profit in the British orders. In the future it will be just as unpatriotic to haggle over a British as an American gun.

Meanwhile the arms production seems to be undergoing a change of tempo. It is tied to the increasing belief in the administration that this coming Spring will decide whether Britain wins or loses the war, while U. S. arms production, more or less inevitably, is geared for maximum output a year from now. And it bears deeply upon the fundamental controversy which has developed within the administration in recent months as to the extent to which a military economy shall be allowed to supersede a civil economy.

Two speeches, by Defense Commissioner Knudsen and Priority Administrator Nelson, delivered the same night and obviously intended to be read together, opened up the question. What made the headlines was Knudsen's admission that arms production, particularly aircraft, is lagging behind the schedules set up last June. Readers of AMERICAN MACHINIST have known of this situation for some time. But this does not necessarily mean that arms production is bogging down. An output of 700-800 planes a month and of four tanks a day, for instance, is nothing to sneeze at. The schedules were drawn on the hope of miracles—and no miracles occurred.

More important in the long run is the new temper revealed. Position of the President so far and of administration economists still is that the defense program can be carried out without restricting the supply of civil commodities and without relaxing any of the New Deal's labor laws. Crucial to this program of course is maximum expansion in those industries which serve both civil and military needs.

Great Expansion Held Unwise

This whole approach has been resented in some sectors of industry. It was felt unwise greatly to expand plant not immediately needed for arms. Even though the government took the capital loss of excess plant after the war, they foresaw that the very existence of such plant would create an extreme buyers' market making difficult the profitable operation of any plant.

This attack upon maintenance of a peacetime economy has now been reinforced from a new direction. The business wing of the defense commission insists that quick arms production—quick enough to do Britain any good—cannot be attained without interference with normal life. "If this program could have been taken in one stride," said Nelson, "with no disturbance to normalcy, then it was too small." To maintain that we can do the arms job and still continue business as usual, he says, is practically "fifth columny."

It is significant that, in urging greater production, Knudsen stressed three-shift, seven-day operation, rather than expansion. Expansion is slow, though it may lead to a greater eventual output. And to expand merely to avoid rationing butter may mean the diversion of attention and resources which could otherwise be devoted to guns.

Clearly evident in the new line is the implication that New Deal labor standards cannot be maintained. That "we can do more work in fewer hours" is a paraphrase, or at least parody, of the President's statement of a few months ago, and it was listed by Nelson among the slogans of the fifth column. Knudsen lined himself up against boycotting Wagner Act violators. Labor must voluntarily work harder and longer, said Nelson. Knudsen is troubled by the same question that arose in the Vultee strike—that labor is not sold on the urgency of the arms program.

Social Legislation Interferes

First official assertion that social legislation has interferred with armament production came with a release this month of the annual report of the Navy's Bureau of Supplies and Accounts. The Walsh-Healey law requiring government contractors to pay time and a half after forty hours and to pay prevailing wages has made it very difficult to obtain bids for Navy supplies, according to Rear Admiral Ray Spears. In particular promulgation of minimum wage determinations for the iron and steel industry has "practically eliminated competition in this industry." Only one steel producer willing to accept Walsh-Healey stipulations produces a complete range of supplies, so that on some items the Navy received only the one bid.

In the case of 2,000 aircrafts clocks the Admiral said it was impossible to get any bids under the act and it was necessary to buy under the open market provisions of the act to get around it. After enactment of the Walsh-Healey Act the number of bids on Navy contracts dropped from an average of 7.49 to a low of about three bids per lots in September 1939. However it rose thereafter to bring the average for fiscal 1940 to 5.03 bids per lot. The Admiral also complained that profit restrictions under the Vincent-Trammel Act had prevented needed expansion of plant by Navy suppliers.

FEW NEW MUNITIONS PLANTS

WASHINGTON—Less than half of the $850,000,000 available to the Army for government-financed munitions plants has been placed to contract. Plants announced to date are estimated to cost under $400,000,000. At least $50,000,000 in additional contracts are expected to come through rather promptly. Plans for considerable of the remaining $400,000,000 are in various stages of completion, with some of them yet to be started. Only one heavy gun plant contract has been let. More are to come, with the balance of the plants covering a wide range of munitions. The plans also cover provision only for 2,000,000 men with the Army thinking of the necessity for 4,000,000.

Assists at G-M

L. C. GOAD

Manages AC Division

GEORGE MANN, JR.

. New Personnel and Manufacturing Heads at G-M

B. D. KUNKLE

F. O. TANNER

NAMES in the NEWS

W. V. C. Auser, former personnel director of Wright Aeronautical Corp., has been appointed to the newly created post of personnel director of Curtiss-Wright Corp.

A. H. Ferbert has been elected president of the Pittsburgh Steamship Co., U. S. Steel Corp. subsidiary, succeeding A. F. Harvey, who is retiring after 39 years of service with the company. The Pittsburgh Steamship Co. operates the lake ore-carrying fleet of the U. S. Steel Corp.

John F. Ditzell has been appointed general sales manager of Shafer Bearing Corp., Chicago. For a number of years Mr. Ditzell was a sales executive of the Stewart-Warner-Alemite Corp.

R. E. Doherty, president, Carnegie Institute of Technology, and Harry T. Woolson, executive engineer, the Chrysler Corporation, have been elected president and vice-chairman respectively of the Engineers' Council for Professional Development. George T. Seabury, secretary of the American Society of Civil Engineers, was elected secretary of the Council.

Robert M. Gaylord, president, Ingersoll Milling Machine Co., has been named president of the Illinois Manufacturers Association. O. M. Burton, Dixie Corp., and H. G. Myers, Gardner-Denver Co., have been named first and second vice-presidents respectively.

J. A. Ingwersen, formerly manager of Midwestern Sales, has been named manager of the Sheet and Strip Sales Division of the American Rolling Mill Co. F. E. Wortley succeeds Mr. Ingwersen.

M. L. Fawcett has been appointed staff assistant at the Westinghouse Electric & Mfg. Co.'s plant at Pittsburgh. J. K. Hodnette has been appointed manager of transformer engineering at the Sharon, Pa., works of the company.

B. D. Kunkle has been appointed vice-president in charge of personnel and F. O. Tanner has been appointed vice-president in charge of manufacturing of the General Motors Corp. W. C. Williams, Jr., another vice-presidential appointee, has been placed in charge of the accessory division. He is also a member of the administration committee.

L. C. Goad, general manager of the AC spark plug division at Flint, Mich., has been transferred to Detroit where he will act as assistant to Mr. Williams. George Mann, Jr., who has been associated with General Motors for 21 years, has been appointed general manager of the AC spark plug division to succeed Mr. Goad. Mr. Mann was formerly assistant secretary and director of industrial relations for the division.

S. M. Jenks has been appointed general superintendent of Gary works of the Carnegie-Illinois Steel Corp. Mr. Jenks succeeds E. E. Moore, who has been elected vice-president in charge of industrial relations.

Norbert K. Koebel, formerly metallurgist with Eastman Kodak Co., has been appointed research director for the Lindberg Engineering Co., Chicago. Ralph Stahl, formerly service engineer in the company's Chicago territory, has been appointed manager of the newly opened Lindberg office at Indianapolis, Ind.

A. B. Morey and C. K. Swafford have been elected vice-president and a member of the board of directors respectively, of the Gisholt Machine Co., Madison, Wis. Mr. Morey who formerly served as treasurer of the company, was succeeded by H. J. Homewood.

H. A. Scallen has been appointed district manager for the Hartford branch of the Jessop Steel Company, Washington, Pa. H. F. Robertson has been appointed sales representative for the company in the same territory.

Arthur B. Purvis, director-general of the British Purchasing Commission in the United States, has been made a Privy Councilor.

Harris E. Thorn has been appointed manager in Philadelphia of John A. Roebling's Sons Co. W. K. Hanna has been appointed manager of the company's Pittsburgh territory.

PLANT EXPANSION

Bethlehem Steel Corp., Los Angeles, has begun construction of several new buildings for its ship building division. The expansions, constructed at government expense, include machinery and equipment which will cost $2,756,000.

A. M. Byers Co., Pittsburgh, will soon begin the construction of added plant facilities. The expansion schedule will enlarge the company's activities to include the production of a broad line of alloy steels, including stainless.

Northrop Aircraft, Inc., Hawthorne, Calif., is erecting a new factory building, which will cover an area of 60x175 ft. will cost $21,000.

J. WALLACE CARREL DIES

J. WALLACE CARREL

J. Wallace Carrel, 73, vice president and general manager of Lodge & Shipley Machine Tool Co. since 1917, died recently at his home in Cincinnati. In point of service Mr. Carrel was one of the oldest men in the machine tool industry. On December 28 he would have completed 52 years in the business, for it was on that date, in 1888, that he went to work for the Lodge & Davis Co., Cincinnati.

He was with this firm from 1888 to 1897, during the changes to the Lodge & Davis Machine Tool Co. and the Davis & Egan Machine Tool Co. At various times he served as manager of the New York store for Lodge & Davis, and as manager of the Cleveland store of Davis & Egan.

About this time Mr. Carrel joined forces with Charles E. Billin & Co. until 1898, when he went with Hill, Clarke & Co., Boston. He remained there until 1902, when he was elected president of Draper Machine Tool Co.

In 1908 AMERICAN MACHINIST wanted a man to tour Europe and study industrial conditions and shop methods. It wanted a man who had the full confidence of industry, and selected J. Wallace Carrel. On his return from Europe he became general sales manager of Lodge & Shipley Machine Tool Co.

Mall Tool Co., Chicago, has doubled its plant area by the purchase of a building and land from Republic Steel Corp., near its present plant. About $100,000 worth of new equipment has been ordered for the 50,000 sq.ft. of additional floor space.

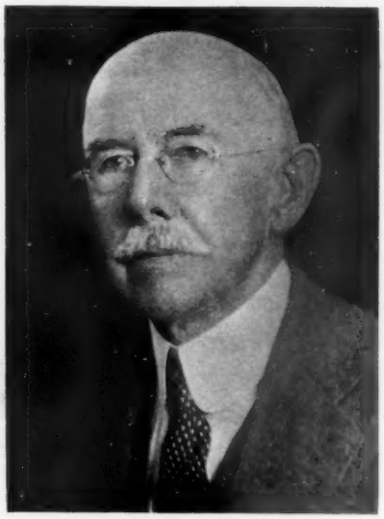
Anacapa Aircraft Corp., Santa Paula, Calif., has begun construction of a new factory for the manufacture of primary and basic training planes.

The Champion Spark Plug Co., Toledo, has let a $70,000 contract for expansion of its plant.

Foote-Burt Co., Cleveland, has purchased the Hammond Manufacturing Co., maker of sensitive radial drills and surface grinders. The Hammond Company was organized in 1916 by officials of Strong, Carlisle and Hammond Co., who have operated it since.

Aluminum Industries, Inc., Cincinnati, has started construction of a new plant unit containing 150,000 sq.ft. of floor space. When the foundry is completed, the company will begin construction of shop for machine operations which will total 300,000 sq.ft. of space.

OBITUARIES



ALVIN IRWIN FINDLEY

Alvin Irwin Findley, editor of *The Iron Age* for 20 years prior to his retirement in 1930, died recently at his home in St. Petersburg, Fla. He had spent 50 years in journalism, 38 of them in the field of business journalism. He spent his early days in Akron, Ohio, and went into newspaper work. He was editor of *Iron Trade Review* (now known as *Steel*) for seven years prior to becoming associated with *The Iron Age*. He was the first president of the National Conference of Business Paper Editors.

Carl Ludwig Grohmann, formerly chief engineer of the Pratt & Whitney Div., Niles-Bement-Pond Co., West Hartford, Conn., died two weeks ago. Mr. Grohmann who was 79 years old, was a member of the American Society of Mechanical Engineers.

Charles J. Reinbolt, 65, formerly shop foreman of the A. F. Oliver Gear & Machine Co., Buffalo, died recently. Mr. Reinbolt had been employed by the company since its organization 25 years ago.

Marshall Williams, 67, a former official of the American Bridge Co., Pittsburgh, died recently.

MEETINGS

Society of Automotive Engineers. Annual meeting, and engineering display. Book-Cadillac Hotel, Detroit, Mich., Jan. 6-10, 1941.

Machine and Tool Progress Exhibition. Sponsored by the American Society of Tool Engineers. Convention Hall, Detroit, Mich., March 25-29.

SHOP EQUIPMENT NEWS

Murchey Single and Double Spindle Machines Designed to Tap and Chamfer Nose End of Shell

Murchey Machine & Tool Co., 951 Porter St., Detroit, Mich., has announced a series of single and double spindle machines especially designed to tap and chamfer the nose end of shell. Illustrated is a double spindle machine arranged with leadscrews to tap and chamfer 4.5 Naval H.E. shell.

Special shell holding fiixtures include hardened and ground pads which locate the shell within a few thousandths of concentricity with the spindle. These pads may be changed for various shell sizes. After the shell is approximately located, it is picked up by an air-actuated female center, which forces the shell forward until the nose end is firmly held in a hardened and ground serrated bushing. This bushing supports the shell rigidly in alignment for tapping and chamfering. It may be changed to accommodate shell of different contour or size. Female center and length of stroke of air cylinder can likewise be changed for various types of shell.

Machine spindles are equipped with Murchey Type M hardened and ground collapsible taps, which include four reaming tools as well as four chasers. The taps are actuated by yokes operating between adjustable stops which trip the taps to predetermined positive thread length and reset the taps for the next operation.

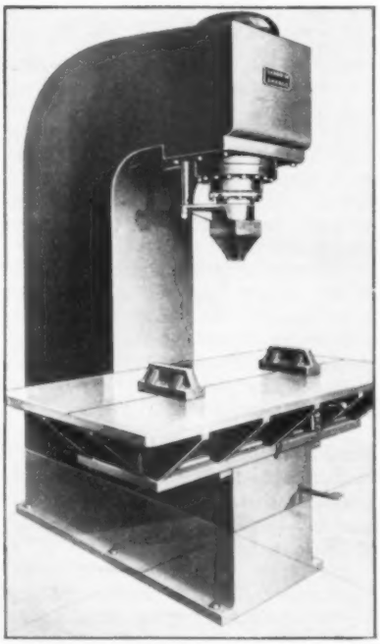
Sequence of operations is to chamfer the shell with the tap chasers collapsed and with the lead screws disengaged. The carriages are then returned, automatically expanding the chasers for the tapping operation, the lead screw is thrown in and the shell is tapped in perfect alignment and with accurate lead. By completing tapping and chamfering in the same spindle, concentricity is maintained and a separate chamfering operation is avoided.

Hannifin Straightening Press Has Capacity of 150 Tons

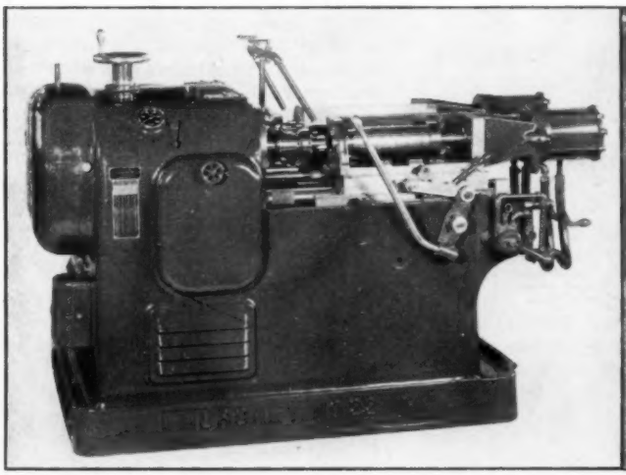
This 150-ton straightening press, built by Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill., is provided with a large table to facilitate straightening steel castings and similar work. Press base is designed for installation below floor level, to bring the table to a convenient height for easy handling of bulky pieces.

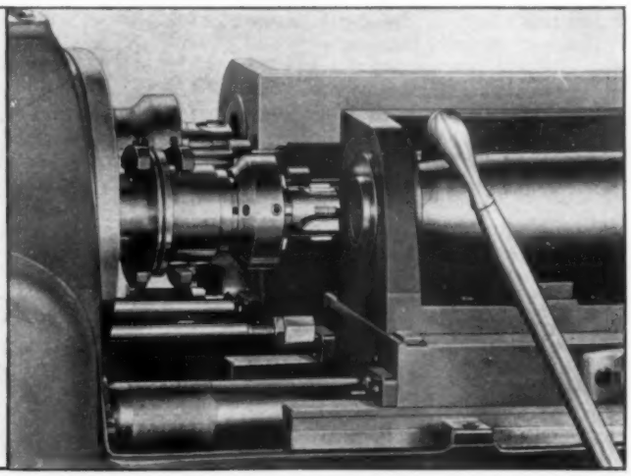
Sensitive pressure control is used, promoting simple and accurate handling. This type of control allows unusually rapid handling of straightening operations, with finger-tip or light foot pedal control of ram movement and ram pressure. Ram movement, both up and down, and pressure control are accomplished by operation of a single hand lever or foot pedal.

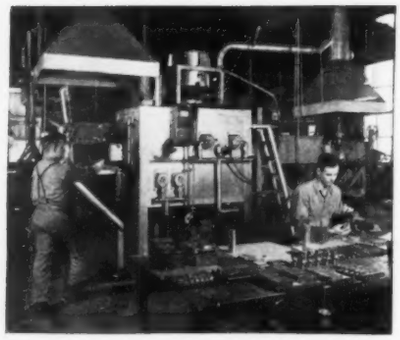
Initial movement of the control lever causes the ram to move down rapidly at nominal pressure. The ram descends until it touches the work, and then stops. Movement of the control lever beyond the approach position causes the ram to exert pressure proportional to the distance the control lever is moved. Any required ram pressure up to the capacity of the press is obtained merely by moving the control lever. Releasing the lever at any point automatically returns the ram to top position with a high-speed return stroke.



The motor-driven hydraulic power unit is built into the press base. Frame is welded, and all piping is concealed. Dimensions: stroke, 20 in.; gap, 30 in.; reach, 30 in. Table measures 54x96 in.







"Char-Mo" Atmosphere Furnace Used for Tool Tip Brazing

Brazing of cemented carbide tool tips to shanks is one of the outstanding uses of the "Char-Mo" atmosphere furnace developed by Surface Combustion Corp., Toledo, Ohio. This controlled-atmosphere furnace maintains absolute surface cleanliness without decarburization of high-carbon shanks.

"Char-Mo" atmosphere, developed a few years ago for heat-treating high-carbon and alloy steels without scale or decarburization, is produced from charcoal in a self-contained generator. This atmosphere is approximately 2/3 nitrogen and 1/3 carbon monoxide, with only infinitesimal traces of water vapor and carbon dioxide. Since the only combustible is slow-burning carbon monoxide which is diluted with two parts of nitrogen, the possibility of an explosion is practically nil.

Generator, which requires no separate heating, consists of a refractory tube which passes vertically through the furnace between the muffle and furnace wall. The tube top is above the furnace and is connected to a charcoal hopper. The bottom is below the furnace, connected to a simple ash remover. Air (from the same blower used to supply combustion air to the burners) is introduced near the bottom of the tube. As the air rises through the tube it reacts with the incandescent charcoal and forms a gas ideally suited for brazing.

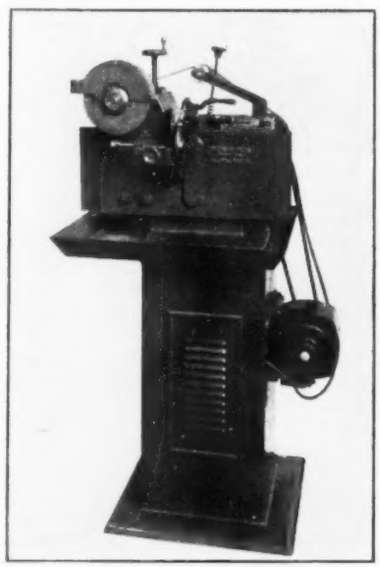
Furnace proper is gas-fired and consists of a preheat zone, a heating or brazing zone, and a cooling zone. Preheat zone is also equipped with burners, used when starting or running heavy loads. Cooling zone is water jacketed for rapid cooling. The protective "Char-Mo" gas is introduced into all three chambers.

Tools are placed on open trays and manually pushed through the furnace. Loading and unloading takes place through side doors. The furnace produces an average of 2,000 pieces per 16 hr. The cycle is 1½ hr., consisting of 15 min. preheat, 5 min. braze, and 70 min. cooling. Amount of charcoal used is 50 lb. per 16 hr.

Wardwell Saw Grinder Indexes Work Automatically

The No. 57T automatic metal saw grinder offered by Wardwell Mfg. Co., 3167 Fulton Rd., Cleveland, Ohio, was designed especially for sharpening form milling cutters, slitting and screw slotting saws in gangs in one setting. The machine automatically indexes the gang of saws, one row of teeth at a time, with the grinding wheel shaped to suit the tooth gullet.

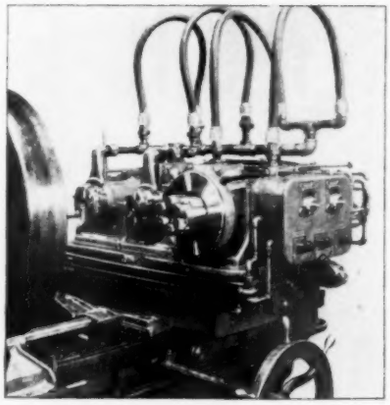
This machine is claimed to be capable of sharpening a gang of saws with a variation of plus or minus 0.001 in. of exact diameter for the entire lot. A group of 250 saws, 0.015 in. in thickness, can be sharpened at one time. Of durable, accurate construction, this machine is equipped for either wet or dry grinding. It handles work from 2 to 8 in. in diameter and in gangs up to 3¾ in. in thickness with tooth spacing up to 1¼ in. Weight of the pedestal type is approximately 625 lb.; weight of the bench-type is about 500 lb.



Special Landis Machine Performs Multiple Operations

Landis Machine Co., Waynesboro, Pa., has developed a recessing, boring and tapping machine which is designed to finish completely the internal or tapped ends of integral joint type casing at one chucking. Similar to the mill type receding chaser pipe threading and cutting-off machine, this device employs a special carriage on which are mounted recessing, boring and tapping tools.

In effecting this arrangement, three tool slides are mounted on a cross slide which can be indexed to bring any one of the tool slides into working position. One tool slide finishes the recess, faces the end of the casing, and chamfers three surfaces in the end. A second tool slide finishes the taper bore preparatory to tapping. The third slide is a special receding chaser collapsible tap arranged to chase the internal thread using the leadscrew mechanism built into the machine.

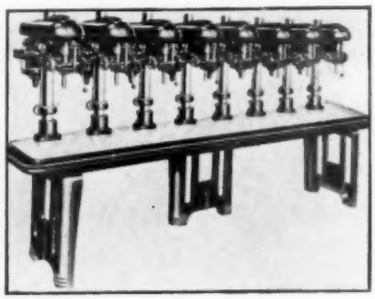


All movements of tool slides as well as those of the cross slide are hydraulically controlled, with the circuits arranged with interlocks to assure correct operating sequence. The cross slide is hydraulically locked into position when any of the tool slides is in action. Controls are conveniently centralized on a panel at the front of the machine, providing the operator full control from a position permitting observation of the tool during machining.

Sectional Drill Press Is Developed by Delta

Delta Mfg. Co., 620 E. Vienna Ave., Milwaukee, Wis., has developed a sectional drill press which permits the user to make up his own drill presses to fit exact needs. By using these sectional drill press production tables it is possible to build up drill presses with from one to an indefinite number of spindles—all 14 in. or all 17 in. or any combination of both—with the drilling heads spaced to fit individual requirements.

Each table section measures 22⅜ in. deep by 30 in. wide (with ends 35 in. wide) with room for two spindles, providing a minimum center-to-center distance of 15 in. Tables are accurately ground and fitted.

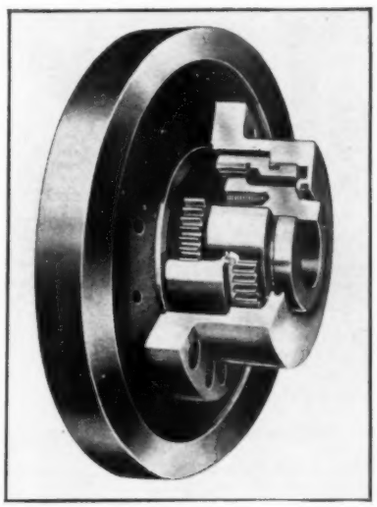


Farrel-Birmingham Offers "Manger" Flexible Coupling

Designed to save space and at the same time secure full flexibility, the "Manger" flexible coupling has been developed by Farrel-Birmingham Co., Buffalo, N. Y. This coupling provides complete flexibility with approximately one-half the axial clearance usually required. A dummy, pilot or stub shaft generally necessary with other types is eliminated. Coupling is equally applicable for connecting two free-ended shafts in combination with a solid flanged half coupling, which gives a close-coupled connection.

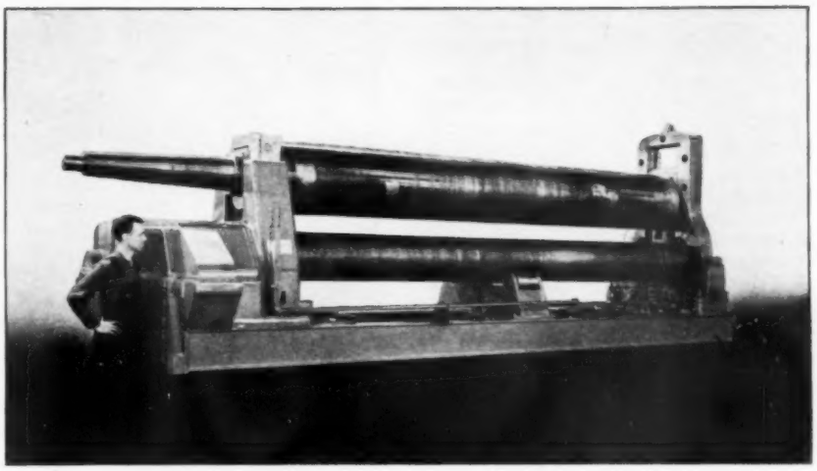
In connecting shafts of different diameters, the coupling is mounted on the smaller shaft and bolted to a half coupling on the larger shaft. Since the size of the flexible member is determined by the size of the smaller shaft, a smaller coupling can be used.

Compensation for misalignment is made by an internal sleeve which floats between an externally geared



hub and an internally geared covering sleeve. The internal sleeve, which engages the hub and outer sleeve, is free to slide and rock, adjusting for differences in alignment. The driving member of the coupling can be either the geared hub or the covering sleeve.

Gear teeth are accurately generated on Farrel-Sykes machines. External teeth are crowned, which gives full freedom to the floating sleeve within the design limits of the coupling. Compensation is provided for offset, angular and combined misalignment without resistance to free lateral float of the connected shafts. Contact areas are large, and heavy oil lubricating the contact surfaces provides a cushion against shock without the necessity of using flexible materials.



16-Ft. Baldwin-Southwark Bending Roll Uses Welded Construction for Simplicity

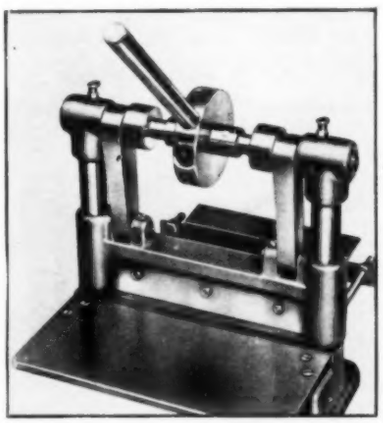
Simplification of design through use of welded construction is achieved in the 16-ft. horizontal bending roll built by Baldwin Southwark Div., Baldwin Locomotive Works, Philadelphia, Pa. This roll provides greater rigidity and better load distribution at the several joints between the drive box, bed rails and inner housing by welding these parts as an integral unit.

Drive gears are arranged to minimize twisting moments set up in this region. Oil-tight boxes bolted to the frame contain nuts and gears for screwing down the top roll. Conical shapes can be rolled by raising one end of the top roll. The two control levers shown in the left foreground operate clutches which permit either end of this roll to be raised or lowered independently.

Cylinders and shapes which must be removed from the machine in a direction parallel to the axis of the rolls are readily handled because of the use of a drop-end housing. Balance bar at the left of the top roll is engaged to support it in a horizontal position while the right housing is lowered to clear that end. A light shop crane can be used for handling this housing, or hydropneumatic operation can be furnished which provides considerably greater speed and convenience.

"Micro" Bench Shear Cuts Medium-Weight Sheet

Intended for work between the heavy floor type foot operated shear and the small thumb and finger operated tinsmith's shear, the "Micro" bench shear built by O'Neil-Irwin Mfg. Co., 316 Eighth Ave. S., Minneapolis, Minn., can be set for accurately trimming metal stampings for die duplicating work and for shearing material to die duplicating size from stock sheets.



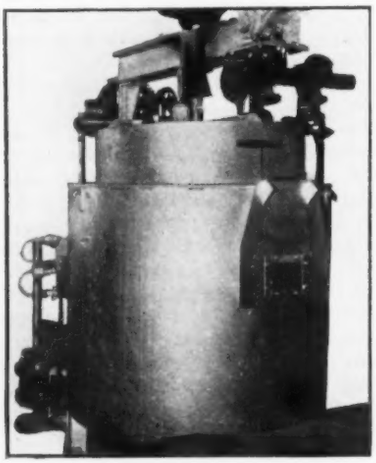
Design of the shear permits close observation of work at all times. The working table can be drilled and tapped for precision gages for die substitute and semi-production work. It is made of steel plate and can be replaced from stock material when required. Material guides provide for accurate shearing to within less than 0.001 in.

Design of this tool allows circular and irregular material to be sheared where only a part of the piece is to be trimmed. Interfering material may be left free of the blade by cutting from around the ends of the shear. Clearance between shearing blade can be adjusted. Maximum shearing width is 6¼ in.; maximum shearing capacity is 24 gage steel plate full width, and 18 gage steel plate of 1-in. width.

General Electric Develops Gas Carburizing Furnace

A gas-carburizing electric furnace for case-hardening steel parts has been announced by General Electric Co., Schenectady, N. Y. This furnace is claimed to offer outstanding advantages over other methods of carburization. A hydrocarbon gas, circulated rapidly through the charge, is used instead of a solid carbon compound as a source of carbon. Since the gas is uniformly distributed in the furnace, a case of uniform thickness forms on every surface, regardless of position in the load. In addition, the furnace can be controlled automatically to reproduce any carburizing treatment, time after time, on a production-line basis.

Operating data are said to show that savings as high as 75 and 80 per cent are made under some conditions when this gas-carburizing furnace in substituted for older methods

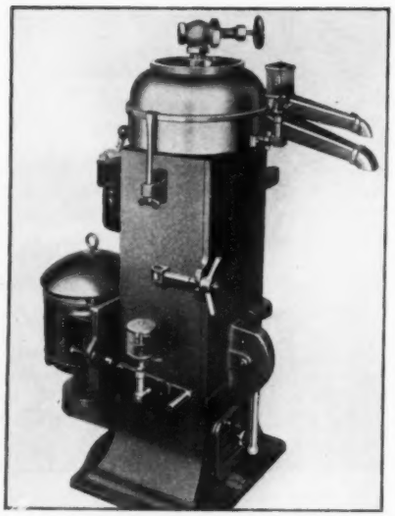


of carburizing. These savings are possible because of the shortened carburizing cycle, elimination of packing material and improvement in quality and uniformity of carburized parts.

Propane gas is passed into the chamber through an inlet in the bottom of the retort at the periphery of the circulating fan. The amount of carbon in the furnace is controlled by regulation of the gas flow. The fan, which is made of heat-resisting alloy, is driven by an easily accessible standard induction motor. Rapid circulation of the gas assures quick heating and uniform temperature distribution.

National Acme Centrifuge Adaptable to Many Uses

The No. C-1 positive universal centrifuge developed by National Acme Co., 170 E. 131st St., Cleveland, Ohio, accommodates a variety of bowls and

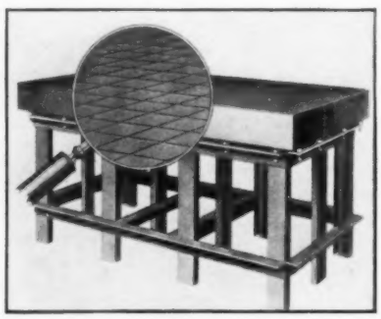


is especially suited to shops using considerable quantities of cutting, lubricating, hydraulic or soluble oils. Available with single or double inner cylinder, wing impeller, enamel spider and special filter, this device is said to save oil, protect bearings and increase tool life. It is claimed to be ideal for installation in built-in oil reconditioning systems.

Challenge Lapping Plate Has 1-16 Inch Grooves

To provide for accurate lapping of delicate joints, Challenge Machinery Co., Grand Haven, Mich., has designed a semi-steel lapping plate having $\frac{1}{16}$-in. grooves, spaced $\frac{1}{2}$ in. apart, running the full length and width of the surface. Joints required to hold oil can be properly lapped with this plate, which is specifically designed to assure a perfect fit when lapping in metal-to-metal joints on which no gasket, shellac or sealer of any kind is used.

A specially designed all-steel stand is available with these lapping plates. It is arc-welded for rigidity and strength and is equipped with closely spaced lock leveling screws to enable the user to keep the plate level at all times. Plates are built in a wide variety of standard sizes, ranging from 8x8 to 52x144 in. Special sizes are built to order.

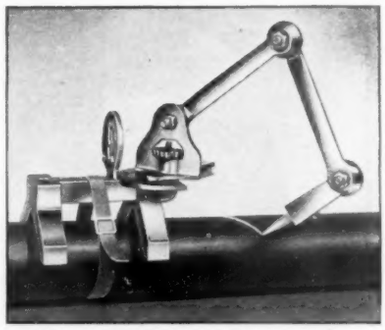


"Trumark Junior" Protractor Makes Accurate Layouts

Accurate layouts for any angle cut on round surfaces are possible with the "Trumark Junior" protractor developed by Tru-Line Corp., 6022 Wilshire Blvd., Los Angeles, Calif. Time and material are saved through accurate cuts made without templets or involved calculations.

On any rectangular form, the instrument is held squared to the edge or corner, the desired angle is set on the protractor scale, and the line marked. The mark goes completely around T or channel shapes. For machining the forward edge, the instrument shows the exact angle of any cut, or can be used as a marking edge on small cuts.

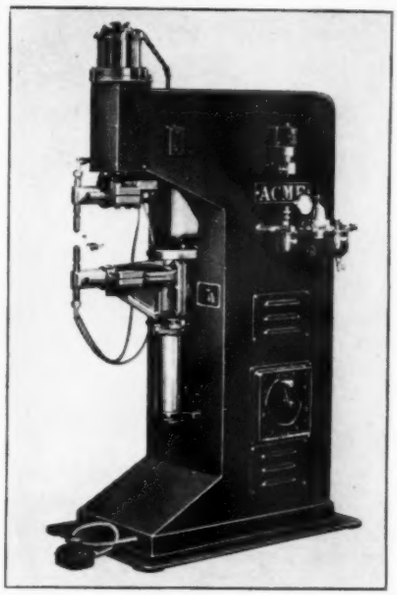
For marking pipe, the "Trumark" is firmly held in place by a strap. Two levels show exact position for the instrument. The desired angle is set on the 180-deg. scale and the flexible marking arm then scribes a line completely around the pipe. The device is all die cast, with marking arms held in position by fiber disks.



More Fluorescent Lamps Announced by General Electric

The Lamp Department of General Electric Co., Nela Park, Cleveland, Ohio, has brought out three new fluorescent lamps. One is a 100-watt 60-in. lamp; another is a 6-watt 9-in. lamp; and the third is a Soft-White lamp made in several sizes.

The 100-watt lamp employs a T-17 tubular bulb measuring $2\frac{1}{8}$ in. in diameter. It is designed for general lighting needs, and produces more than double the amount of light given off by the standard 40-watt 3500 F. white fluorescent lamp, with only a slight increase in surface brightness. The 6-watt lamp employs a T-5 round bulb and miniature bipin base. This lamp of daylight and 3500 F. white permits use of fluorescents in many places where larger lamps are not practical. The new soft-white lamps come in 15, 20, 30, and 40-watt sizes and in 18, 24, 36, and 48-in. lengths. The 15 and 30-watt sizes have T-8 bulbs; the 20 and 40-watt sizes have T-12 bulbs.



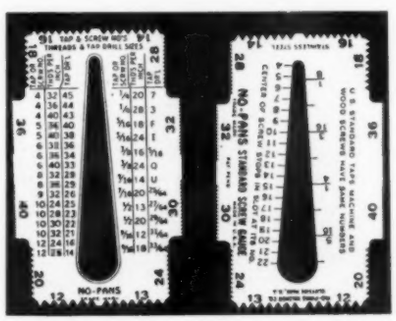
Acme "Hot Spot" Welder Is Operated by Air

Type PT-1 air-operated spot welder is manufactured by Acme Electric Welder Co., 5621 Pacific Blvd., Huntington Park, Calif., in capacities from 30 to 150 kva. In the smaller capacity welders throat depths are available from 12 to 30 in., while in the larger capacities throats range from 12 to 48 in. Eight steps of heat regulation are standard, but up to 32 steps can be supplied.

Base is of all-welded steel construction. Features include water cooling of secondary, column and electrodes, universal double end reversible horns, positive-locking heat switch, and complete air equipment.

Standard Screw Gage Made Available by No-Pans

No-Pans Washer Co., 383 Nelson Ave., Cliffside Park, N. J., has developed a standard screw gage which gives screw sizes for machine screws from No. 4 to No. 22 and for wood screws from ⅛ to $\frac{5}{16}$ in. This tool also gives 12 machine screw threads and 29 tap holes to drill for machine screws. Made of stainless steel, the device measures 2½ x 1½ in.



Improved Thomson Meter Measures Welding Pressures

Improvements in the design of the resistance welding pressure meter developed by Thomson-Gibb Electric Welding Co., 164 Pleasant St., Lynn, Mass., insure greater precision, permanent accuracy and a wider selection of calibrations. Meter consists of an oil-filled diaphragm connected to a gage made with a bronze-bushed movement. Dial is calibrated to read directly in pounds. A plunger tube plug stabilizer in the stem protects the gage against damage from sudden application of pressure, and eliminates danger of the needle being forced off the scale or turned on its shaft.

The diaphragm unit is resistance welded throughout, the pads being welded to the diaphragm plates which are seam welded together. The stud into which the gage is screwed is welded to the diaphragm. Gages are available in capacities up to 350,

550, 800, 1600, 2500, 4000, 5000 and 6000 lb. They are chromium plated, have beveled glass faces and are individually packed in wooden boxes.

"Protexteel" Metal Coating Defies Abuse and Corrosion

"Protexteel," developed by Watson-Standard Co., 225 Galveston Ave., Pittsburgh, Pa., is claimed to dry hard in any weather, resist abrasion and abuse, and to defy corrosion. Consisting of a primer and finish coat, these compounds arrest corrosion by zinc chromate pigments, and afford lasting protection with a Bakelite varnish. Finish coat is said to provide a long-lasting, highly elastic and extremely durable surface strongly resistant to abrasion, even under handling and erecting processes.

Atlas Milling Machine Handles Smaller Work

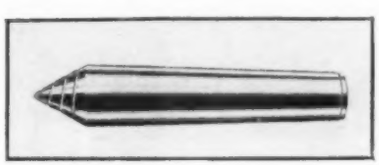
The bench milling machine built by Atlas Press Co., Kalamazoo, Mich., has been designed for improved efficiency, versatility and economy on small piece milling. This tool handles the full range of milling operations from heavy slabbing and facing to light end milling, keyways, finishing and layout work.

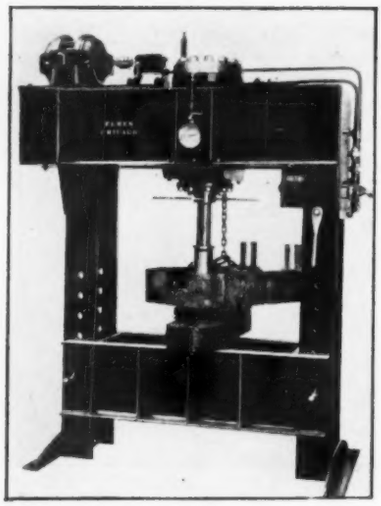
In this machine three types of table controls are available: standard screw feed, rapid-production lever feed, and "Changeomatic" feed for instant selection of automatic table feeds. A wide range of spindle speeds provides correct surface speeds for all types of work and cutters. Swivel vise, rotary index table, indexing centers, and coolant system are available.

Specifications: table working surface, 4½x18 in.; longitudinal table travel, 12 in. (10 in. with "Changeomatic" feed); vertical table travel, 6 in.; approximate over-all dimensions, 25½x32½x22 in.

Grooved Lathe Center Improves Work Lubrication

It is claimed that work turned between centers need never be relubricated when the Type CMD helical groove lathe center is used in the tailstock. This lathe center, offered by Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago, Ill., holds an ample supply of lubricant and permits it to flow down where it will do the most good. Left-hand grooves prevent excess lubricant from dripping or being forced out of the work by rotation. Center is available in sizes from No. 0 to No. 6.



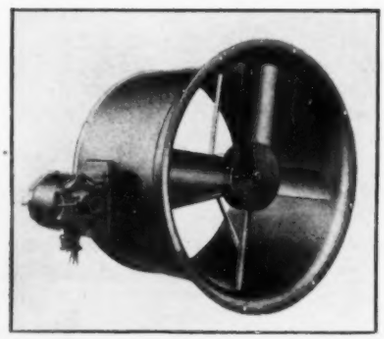


Elmes Hydraulic Press Handles General Work

A large volume and wide variety of general shop work can be handled efficiently with the hydraulic press developed by Charles F. Elmes Engineering Works, 230 N. Morgan St., Chicago, Ill. With a 12-in. screw adjustment and a 12-in. ram stroke, this model has a total stroke of 24 in. Platen is adjustable by means of a ratchet gear. Control is by a single lever. Maximum accessibility during operation is obtained by a simple frame of all-welded steel. Capacities and sizes to suit nearly all requirements are available, beginning with a model powered by 1½-hp. motor.

Paint Spray Booth Fan Developed by DeBothezat

A paint spray booth fan placed on the market by DeBothezat Ventilating Equipment Div., American Machine & Metals, Inc., East Moline, Ill., assures protection against hazards of spray painting under all operating conditions. Built to Underwriters' specifications, this fan is corrosion-resisting and non-sparking. Motor is substantially mounted and balanced outside the fan housing on an adjustable base, and power is transmitted by V-belts through a vapor-proof drive chamber. Fan wheels are of die-formed aluminum, with blades readily removable.



Bonney Forge & Tool Works Offers Soft Face Hammers

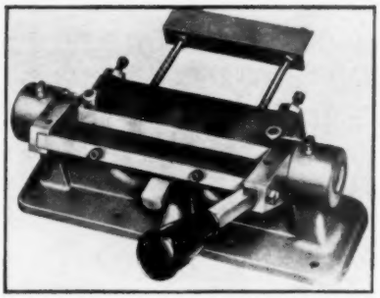
Five additional types have been added to the line of soft face hammers made by Bonney Forge & Tool Works, Allentown, Pa. The new types and sizes are especially useful where a hammer is required that will not mar finely finished surfaces or delicate machine parts. They are also useful for forming and working light sheet metal.

Hammers are available with one regular face tip and one ball pein tip; with one straight pein tip and one cross pein tip; with two ball pein tips; with one square tip and one offset pein tip; with two regular face tips and with one regular face tip, and one regular face tip with brass insert. All tips are renewable. They are made of a tough, amber colored, cellulose composition that will not shatter or chip. Hickory handles have comfortable grip and are securely wedged in the steel center body. Head weights range from 1½ oz. to 2 lb.

Sheet and Strip Formed With "Micro" Bench Brake

O'Neil-Irwin Mfg. Co., 316 Eighth Ave. S., Minneapolis, Minn., has developed the "Micro" bench brake for precision forming of angles and channels from sheet and strip stock. This tool will handle materials in sizes from ⅛ in. up. It will also form angles, brackets, vees and other types of folding to 110 deg.

Folding operations are completely visible, allowing the operator full control. Horizontal and vertical adjustment of the folding plate is provided for accurate setting to form either acute or obtuse angles. Accurate folding stops are provided for duplicating all operations to within 0.001 in. Material guides can be quickly adjusted for accurate metal duplicating, and rapid folding of sheet material on a semi-production basis. Maximum folding width is 6 in. Maximum folding capacity, full width, is 18 gage steel plate. Maximum folding capacity, 4 in. width, is 16 gage steel plate.



Oil-Immersed Starter Features Better Protection

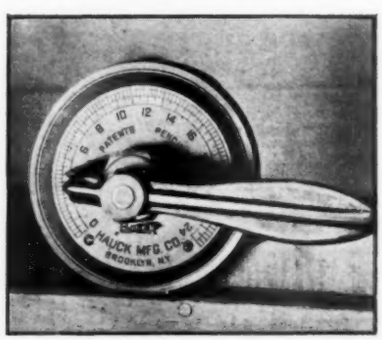
General Electric Co., Schenectady, N. Y., has developed an oil-immersed combination starter for use in corrosive or hazardous gas locations. The device is available with or without a circuit breaker.

To facilitate installation, a one-piece cast-iron head, used in both forms, permits conduit entrance from five directions. As protection against external corrosion, stainless steel and Monel metal are used for all exposed parts. Copper-bearing steel tank and cast-iron head provide additional protection. Reversible tips prolong contact life, and protection against harmful overloads is supplied by an isothermic induction-temperature relay immersed in the oil.

"Micro-Cam" Oil Valve Has Straight-Line Flow

Flow is directly proportional to the area of the slot opening and to the number on the calibrated dial in the "Micro-Cam" oil valve developed by Hauck Mfg. Co., 124 Tenth St., Brooklyn, N. Y. This instrument is claimed to take guess work and uncertainty out of regulating oil flow on any type of burner.

Flow of oil is governed by a cam with a knife edge rotating against a V-slot in a flat plane. Operator can easily repeat the previously determined settings with full assurance of duplicating results. Concentrated free opening minimizes clogging.



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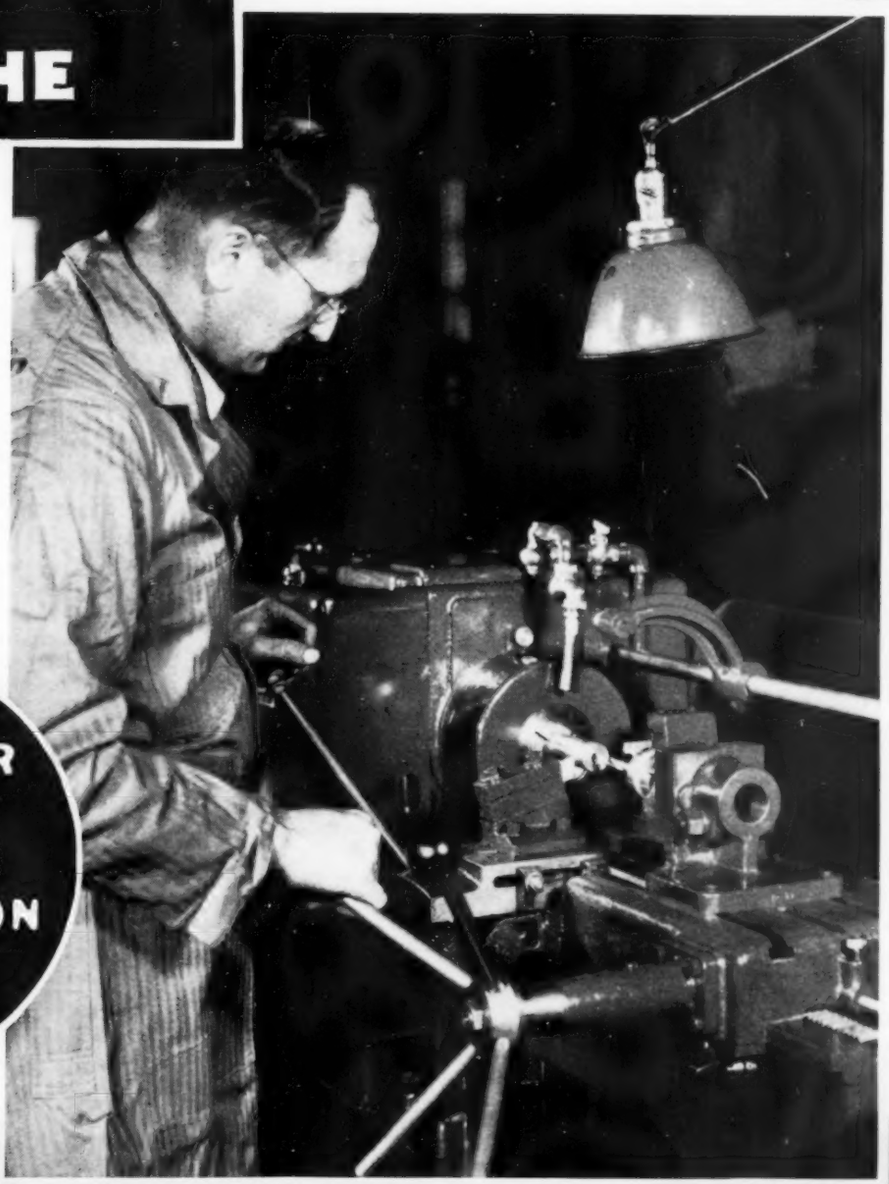

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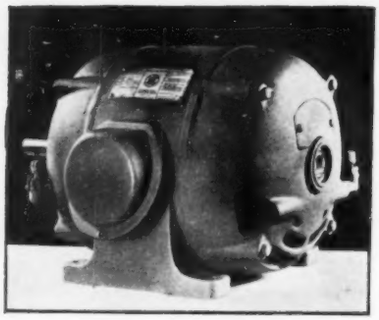


Westinghouse Induction Motors Are Lighter and Smaller

Type CS sleeve-bearing squirrel-cage induction motors have been designed especially for general purpose applications such as machine tools, pumps, and auxiliary drives by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These motors are available in ratings from ½ to 5 hp., at speeds from 875 to 3600 r.p.m. for operation on 110, 220, 440, and 550 volts, 2 and 3 phase.

More attractive and compact, the motors are also stronger mechanically. Rigid complete cast frames maintain constant air-gap between stator and rotor, assuring high efficiency. Frame improvements include new sealed sleeve bearings having a combination vestibule and felt washer seal, and a larger oil reservoir capacity. Oil filler cups may be inserted on either side of the motor.

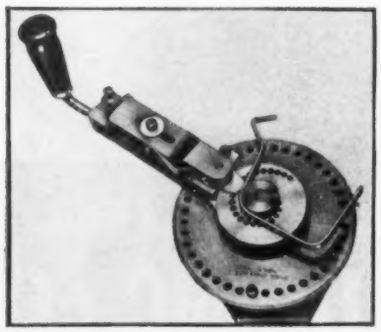
New wire insulation gives maximum dielectric strength, toughness, and flexibility. Combination slot cells, with reinforced cuffs, protect windings from abrasion, and coil ends are taped for reinforcement against strains of full voltage starting. All motors are dynamically balanced, and windings are given a high-voltage radio frequency test.

"Micro" Duplicating Bender Forms Parts Accurately

In many cases the expense of making dies or die sets can be eliminated by the use of the "Micro" die duplicating bender made by O'Neil-Irwin Mfg. Co., 316 Eighth Ave. S., Minneapolis, Minn. This tool is also said to bend metal pieces to shapes which are impractical, or in some cases impossible to obtain with blanking or forming dies.

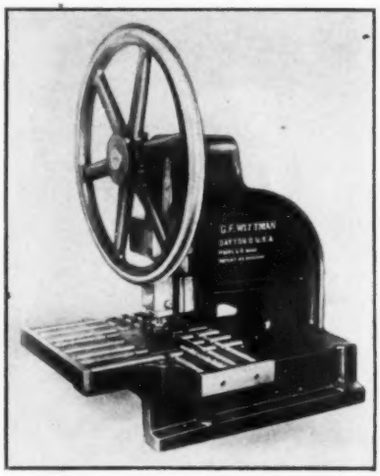
Range of contour bending and die duplicating operations is limited only by the expansion and contraction limits of the material. The tool will receive without alteration simple conversions for forming angle, channel, rod, round or square tube. Half-rounds or flat wire and strip can be bent on edge.

Conversions are quickly made from regular stock materials with simple lathe and hand tools. Work can be held to tolerances not exceeding 0.001 in. Stops may be set and material guides mounted for semi-production work up to 1,000 operations per hour.



Improved Spacing Machine Provides for Short Runs

Recommended especially for experimental work and short-run production is the improved spacing machine offered by G. F. Wittman Co.,



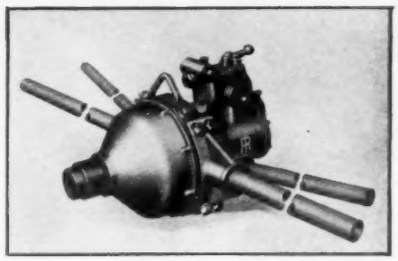
20 Northwood Ave., Dayton, Ohio. Two styles of this machine are available—the spacers and follow-up presses. Follow-up presses are the same in construction as the spacing machine, with the exception that the spacing plate is removed and a different type stripper is used.

Outstanding advantages of this improvement are ease of operation and quick change-over for short-run production lots. This is claimed to reduce greatly the cost of experimental parts and limited production lots.

Specifications: Punching capacity, 15,000 lb.; throat, 8 in.; stroke, ½ in.; weight, 370 lb.

"Multi-Vane" Motor Used In Flue Rolling Machines

Identified as Nos. 55-Q and 55-R, two flue rolling machines introduced by Ingersoll-Rand Co., Phillipsburg, N. J., are powered by "Multi-Vane"



air motors. These machines have been built for rolling extra large tubes such as used in oil refinery stills, for tapping, running in and removing large pipe plugs, for tapping flue sheets in large boilers, and for heavy reaming, such as in propeller shaft couplings.

Working speeds are very low, with correspondingly high torque. Size 55-Q has an average working speed of 32 r.p.m. Size 55-R has an average working speed of 20 r.p.m., and about 50 per cent greater torque than the 55-Q model.

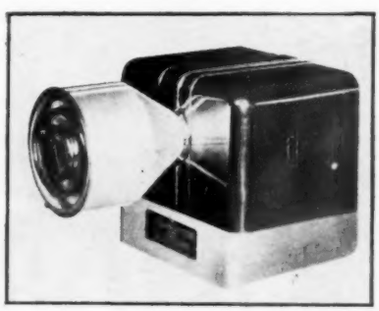
"Bradex" Fixture Cleaner Offered by Bradley Washfountain

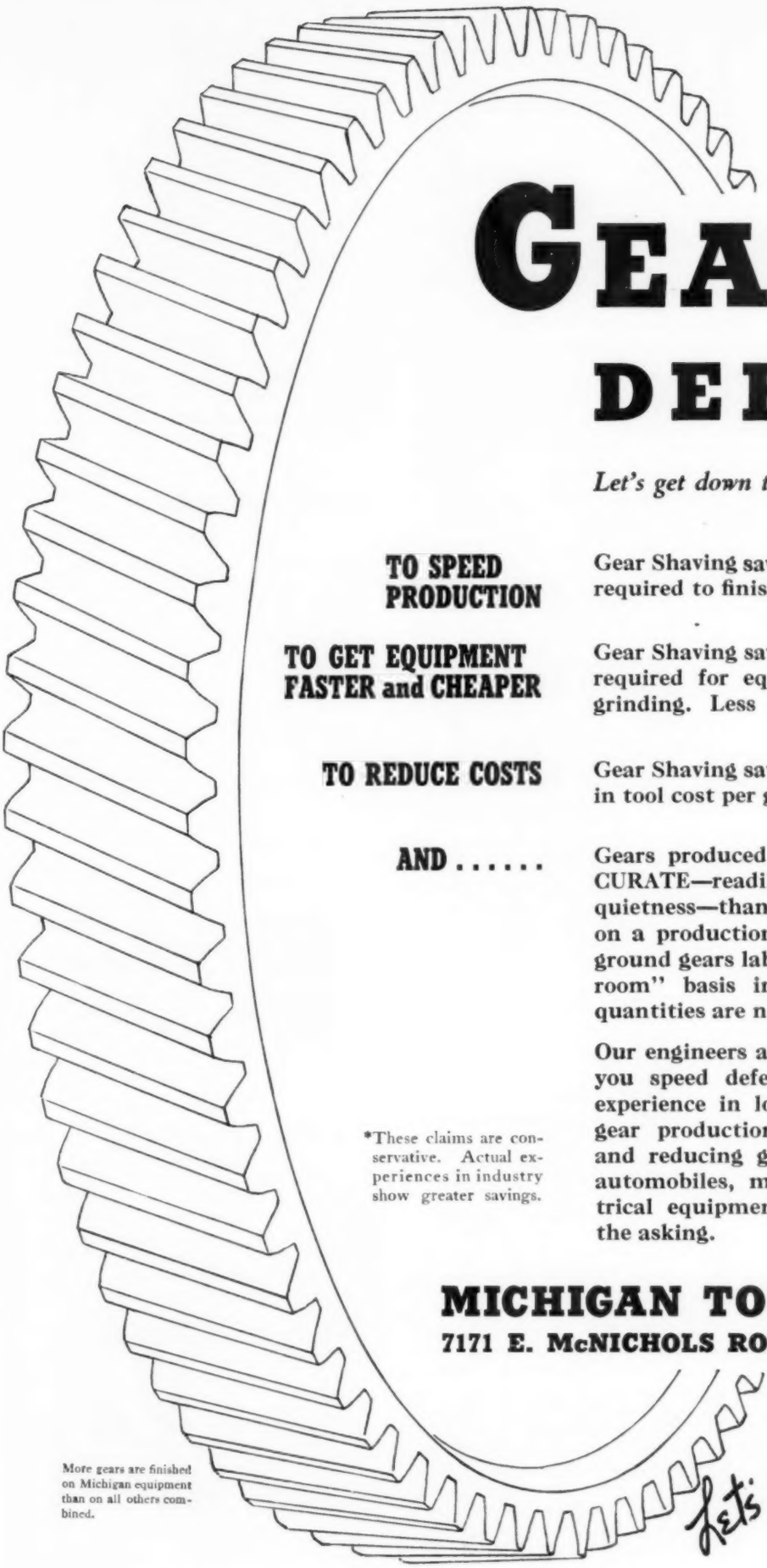
Bradley Washfountain Co., N. 22nd & W. Michigan Sts., Milwaukee, Wis., has developed "Bradex" cleaning agent especially for washfountains, multi-stall showers and drinking fountains. This compound, which can be used on all washroom facilities, is claimed to be economical, safe, easy to use and highly effective.

G.E. Photoelectric Relay Made for Many Applications

General Electric Co., Schenectady, N. Y., has developed a compact photoelectric relay for a wide variety of general-purpose applications. This relay operates at speeds up to 150 interruptions per minute and at a minimum of 40 foot-candles at the phototube with not more than 15 foot-candles of extraneous light.

Applications include counting, sorting, weighing, measuring, controlling, signalling, inspecting and regulating. The relay has a controlled contact rating of 10 amp. at 115 volts a.c., with two normally open and two normally closed contacts. Relay coil is energized when the light at the phototube falls below 30 foot-candles.





GEARS *for* DEFENSE

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TO SPEED PRODUCTION

Gear Shaving saves 4 months out of every 5* required to finish gears by grinding.

TO GET EQUIPMENT FASTER and CHEAPER

Gear Shaving saves 5 dollars out of every 6* required for equipment to finish gears by grinding. Less equipment—faster delivery.

TO REDUCE COSTS

Gear Shaving saves 7 dollars out of every 8* in tool cost per gear compared with grinding.

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Gears produced by shaving are MORE ACCURATE—readily proven by their greater quietness—than those produced by grinding on a production basis. (Excepting of course ground gears laboriously produced on a "tool room" basis impossible where production quantities are needed.)

Our engineers are ready and anxious to help you speed defense gear production. Their experience in lowering gear costs, speeding gear production, improving gear accuracy and reducing gear failure for producers of automobiles, machine tools, tractors, electrical equipment, trucks, etc. is yours for the asking.

*These claims are conservative. Actual experiences in industry show greater savings.

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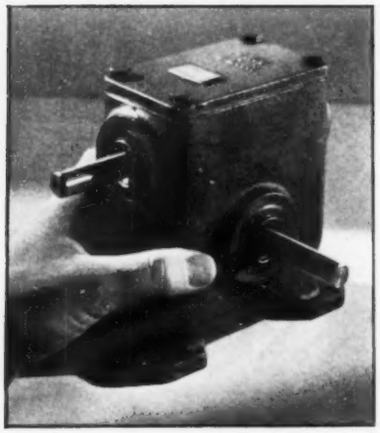
More gears are finished on Michigan equipment than on all others combined.

Let's eliminate this bottleneck, too today—



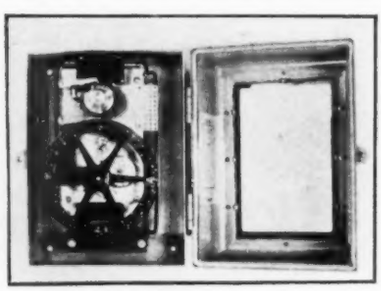
Ohio Gear Speed Reducer Handles Fractional Horsepower

The BHU speed reducer developed by Ohio Gear Co., E. 179th St. & St. Clair Ave., Cleveland, Ohio, is offered in three assemblies with output shaft projecting to right, to left or to both right and left. Only 5⅜ in. long, 3 in. wide and 5⅝ in. high, this fractional-horsepower reducer is available in stock ratios between 10:1 and 48:1. A bronze worm wheel and a hardened and ground worm operate in Timken roller bearings. Torque capacity is 150 in.-lb.

Cramer Program Switch Features Extreme Precision

The synchronous motor-driven automatic program switch offered by R. W. Cramer Co., Centerbrook, Conn., can be pre-set to close an electrical circuit for from 5 to 25 seconds, precisely at any 5-minute intervals of the 24 hours. The machine will handle up to 30 operations per day.

The 5-minute dial is divided into minutes, halves and twelfths. Setting this dial on time sets all other dials. It can be set accurately to the second and since the main contact is actuated by a double cam integral with this dial, switching is as accurate as the setting. A 60-minute hand serves for ready time checking, in relation to both the 5-minute and the 24-hour dials. The 24-hour dial serves as the program wheel. It has a threaded hole for each 5-minute interval. Pins screwed into the appropriate holes determine signalling and switching program. Device is easy to set and easy to change.



Hydraulic Elevating Table Operated by Foot Pedal

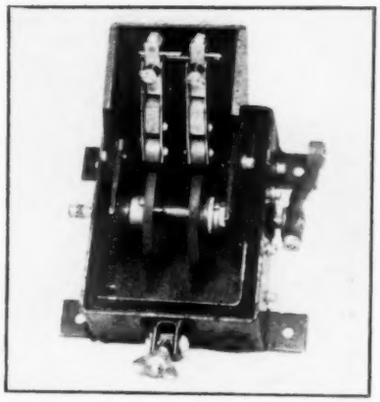
Short, easy strokes on a foot pedal operate the hydraulic elevating table developed by Lyon Iron Works, 587 Madison St., Greene, N. Y. This table is useful in moving dies in and out of presses, in lifting or supporting overhanging work on drill presses and in transferring heavy materials or parts from one machine or work bench to another.

Elevating and lowering by means of foot pedals leaves the operator's hands free for the work. Table is guided so that it cannot swivel. Base is the same size as the table, allowing the table to be pushed up close to a machine without any interference from the base. Casters are located at the extreme corners, giving maximum stability. Table measures 24x30 in. Lowered height is 28 in.; elevated height is 42 in. Capacity is 2,000 lb. Weight is 350 lb.

Cam-Operated Limit Switch Built for Control Circuits

The XC-23 cam-operated limit switch with contacts arranged to swing open for easy inspection and maintenance has been designed especially for control circuits of such devices as hoists and industrial trucks by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This switch is available with ratings of 2 amp. at 600 volts d.c. and 25 amp. at 110 volts a.c. It has two contacts, either or both of which may be normally closed or normally open.

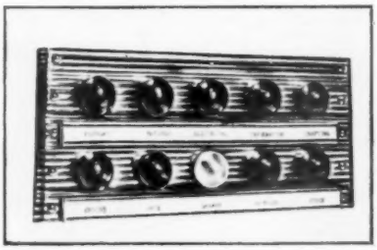
A special feature of the switch is the Micarta fingerboard on which the contacts are mounted; it swings upward out of the case for easy connecting, inspection and maintenance. The switch is housed in a sheet steel weatherproof case. Operation is by a camshaft on which rollers travel. These rollers make or break contacts at any point on the travel. The switch may be actuated either by a revolving shaft coupled to its camshaft, or by movement of an operating lever attached to the camshaft. Moving contacts are self-aligning, with a compensating operating finger.



Standard Mounting Strips Introduced by Kirkland

To facilitate use in multiple of signal lights, toggle switches and pushbuttons, H. R. Kirkland Co., Morristown, N. J., has developed a line of standardized mounting strips. These strips are similar to those used in the construction of telephone switchboards.

They are of stainless steel, with a rippled finish and beveled ends. Strips are furnished with all devices mounted on them, ready to install. They are available in three lengths, to contain two, three, or five units per strip. There is a designation strip to match each length.

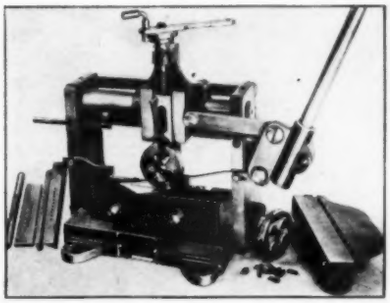


Goggle Safety Shield Developed by Kimball

Kimball Safety Products Co., 7314 Wade Park Ave., Cleveland, Ohio, has developed a cellulose acetate side shield for use on workmen's spectacle-type protective goggles. The purpose is to provide added pro-

tection against particles getting into the eye from the side, while at the same time not interfering with vision.

The shield is inexpensive, yet durable. It is easily applied or replaced by merely slipping it on over the temple or ear piece. It is available either clear or tinted.



Bates Marking Machine Stamps Irregular Parts

Round, flat and tapered articles can be marked with the No. 9 marking machine developed by H. O. Bates, (The Acromark Co.) 245 N. Broad St., Elizabeth, N. J. This device is capable of marking names, specification numbers and other information on a variety of sizes and shapes of parts. Marking area is sufficient to take parts up to 10x4 in. For round pieces the product is rolled as a flat die impresses the mark. For flat parts the impressions are made with a roller die. Holders take steel type for solid lettering dies and are quickly interchangeable for any marking.

Inconvenient Places Lighted By Emeloid "Mekanix-Lite"

Lucite plastic is used in the "Mekanix-Lite" offered by Emeloid Co., 287 Laurel Ave., Arlington, N. J. The well known property of this plastic of transmitting light through a curved rod permits tne spotlighting of hard-to-see places and loca-

tions difficult to reach. Lucite adapters come in several shapes, one of which has a permanent magnet at the outer end with capacity to lift $\frac{3}{4}$ oz. Adapter, which is claimed to be practically unbreakable, threads into the end of an ordinary battery-operated flashlight.

War machines and munitions have to be good to stand up under war conditions. They must be made rapidly in huge quantities by a variety of plants. All parts must be strictly interchangeable.

Hence the task of guarding quality becomes a matter of life and death importance to a nation rearming to preserve its liberty.

Sheffield Visual Gages are stalwart guardians of dimensional quality. They are used in checking dimensions of manufactured and purchased parts, tools, production and master gages.

The sturdy Reed Mechanism, combined with the light beam lever arm, provides a sensitivity to meet the highest precision standards of measurement—but without the delicate fragility so often associated with sensitivity.

These gages are not delicate, they are strong and deadly accurate. They are made in various models to check accurately to thousandths, "tenths" or millionths of an inch and all provide rapid, easy gaging to any limits required on production work.

Write for information.

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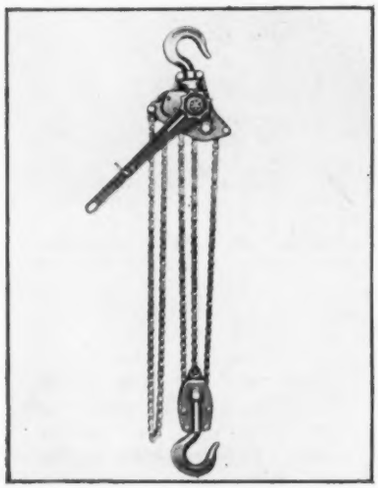
MASTER GAGEMAKERS

New "Pul-Lift" Hoist Has Capacity of 4½ Tons

The "Pul-Lift" portable hoist announced by Philadelphia Div., Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia, Pa., has a capacity of 4½ tons. Great strength with light weight is achieved through the use of alloy steel.

The roller chain is specially designed and has an ultimate strength nearly five times the rated capacity of the hoist. A feature of the device is that it operates equally well in



horizontal or vertical positions.. Thus it can be used for both pulling and lifting and is suitable for almost any type of maintenance job. For operation in close quarters, it has a ratchet handle with a universal action. Short, easy strokes at any point within a complete circle permit operation. Possibility of flying handle is decreased to a minimum by a self-actuated load brake.

Toggle Clamp Templets Offered by Detroit Stamping

To save the time of tool designers in figuring and detailing toggle clamps for holding parts in production fixtures, Detroit Stamping Co., 343 Midland Ave., Detroit, Mich., is giving away sets of templets, scaled precisely to the new toggle clamp dimensions. Eighteen separate templets are provided, ranging from light up to air operated heavy duty models. Each is reproduced on hard finish parchment paper.

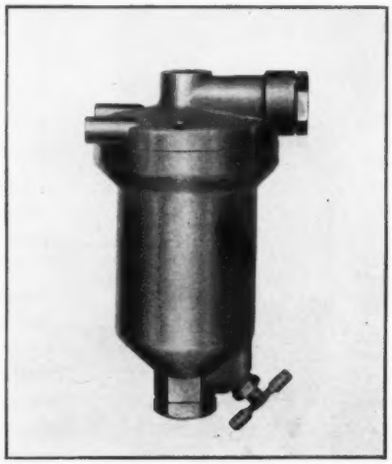
Hygrade Sylvania Announces 200-Watt Fluorescent Fixture

Hygrade Sylania Corp., Salem, Mass., has developed 200-watt "Miralume" fluorescent lighting fixture which makes use of four 40-watt fluorescent lamps, either daylight or white. This No. C-205 fixture is 49 in. long, 14½ in. wide, and 7½ in. deep, and weighs approximately 45 lb. It is provided with plastic diffusing panels and bottom louvres.

DeVilbiss Automatic Drain Used on Compressed Air Lines

Type HOD automatic water drain for use in compressed air lines, claimed to be simple in construction, positive in action, and trouble-free in operation, has been developed by DeVilbiss Co., Toledo, Ohio. This device, available with four convenient fitting assemblies, automatically drains the air line or air receiver, preventing water from being carried into the tool being used. It thereby prevents rusting and corroding, and assures an air supply free from moisture. Its use is especially desirable in spray painting, where it insures against possible moisture deposit on freshly finished surfaces.

The unit operates antomatically by slight fluctuation of the main line air pressure. A variation of as little as 5 lb. is sufficient. A manual drain is provided for use in periods when the main air line is not in use.



Haynes Stellite Announces "Star J-Metal" Alloy

"Star J-Metal" is the latest cobalt-chromium-tungsten metal-cutting alloy announced by Haynes Stellite Co., 30 E. 42nd St., New York, N. Y., a unit of Union Carbide & Carbon Corp. Thorough tests on production jobs prove these tools to be a substantial improvement over the former standard grade of Stellite "J-Metal" in life between grinds. It is recommended for all machining operations on cast iron, semi-steel, steel, or other materials. The new tools can be operated under the same conditions as the original grade and are ground with the same wheels, at the same speeds and feeds. Tool life between grinds is, however, substantially longer. In some cases, improvement in cutting quality makes possible higher speeds and feeds.

"De-Ion" Circuit Breaker Handles Heavy Loads

The Type DH "De-ion" air circuit breaker, designed especially for indoor circuit protection in industrial plants by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is available in ratings from 100,000 to 250,000 kva. interrupting capacity; 600, 1200, and 2000 amp. for operation on 2500 and 5000 volts, three phase, 60 cycle power. Features include inlaid silver-to-silver main contacts; arcing contacts of special tungsten alloy; and isolation of high voltage and control circuits.

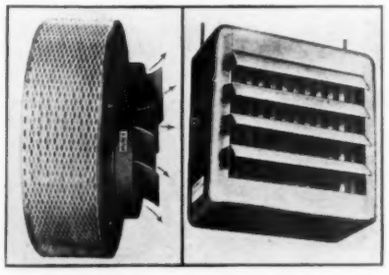
Closing operation is of the solenoid type, with a mechanism mechanically and electrically trip-free. Contact opening is accelerated by springs. Principal advantage of this construction is its high speed, resulting in only a half cycle of arcing at most current values.

Potassium Cyanide Made In U.S. by du Pont

Manufacture in the United States of potassium cyanide, a strategic chemical employed in hardening tool steels, has been announced by R. & H. Chemicals Dept., E. I. du Pont de Nemours & Co., Wilmington, Del. This chemical was formerly imported, but none of the imported material is now available. In addition to its importance in heat-treating steel, the material is valuable in electro-plating metals.

"Murco" Unit Heaters Made In Two Types

D. J. Murray Mfg. Co., Wausau, Wis., has developed the M Series "Murco" unit heaters in both standard and vertical projection types. Design of

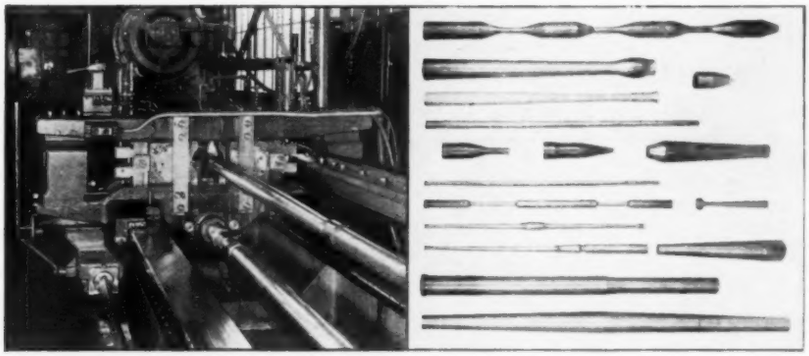


the individual copper spiral fin tube core provides even air distribution at high velocity. Individual tubes prevent stresses due to unequal expansion.

Entire unit is spring suspended and floats free in the casing, thus eliminating rigid connections between the cabinet and unit. Heaters are made in 27 models for steam, and 8 models for hot water. Each type of heater is finished in baked crinkle enamel.

NEW MATERIALS

Long Lengths of Tapered Tubing Made Possible by Dewey Tube-Forming Process



Tubing with tapers up to 20 ft. long or with any combination of tapers and curves in the same length, with reductions in diameter up to 50 per cent, are possible with the Dewey tube-forming process developed by Steel & Tubes Div., Republic Steel Corp., Cleveland, Ohio. Thus are opened up new possibilities for economical use of tubing. For example, tubular automotive propeller shafts can be made a constant-strength beam by tapering from the ends to the center, instead of tapering for only a short distance from each end. Aircraft landing gear struts can follow similar design, instead of using a stamped and welded assembly.

In machines using the Dewey process, tubing is passed through a closely fitting bushing mounted on a transverse forming carriage, its ends being gripped in headstock and tailstock chucks. Headstock chuck is turned by power, the tailstock chuck running free. Headstock is pulled along the ways by a hydraulic piston to keep the tube under tension and take up its increase in length as it is reduced. Forming carriage moves from tailstock to headstock, the centralizing bushing engaging the tubing just ahead of the forming rolls which move radially, their motion controlled by a templet bolted to the machine bed. Roll housings are geared together so that one templet actuates both rolls at the same time.

Machine shown handles tubing as heavy as No. 8 gage up to 4 in. in diameter. When forming 2-in. tubing, wall thickness ranges from 20 to 10 gage. Percentage reduction depends on analysis. On boiler tubing, reduction has reached 50 per cent. For brass and Monel, reduction may be 60 per cent of the original diameter. Either welded or seamless tubing can be handled, but it must be free from flaws. It should also be uniform in temper to within usual commercial limits.

Wall thickness is affected by the roll-face radius, the axial load applied to the tubing, and the rate of feed of the forming roll carriage. A sharp roll face radius thins the metal at points of severe reduction. A wider radius thickens it. Control of axial loads and roll feeds permits the metal to be displaced within wide limits. It is possible to control thickness of all portions of the work. Scrap is low, being only the few inches at each end required for chucking.

"Castolin" Brazing Alloys Melt at Low Temperatures

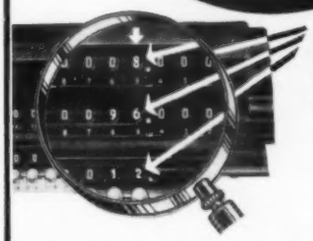
"Castolin" low-temperature welding and brazing eutectic alloys, formerly imported into the United States, are now being manufactured by Eutectic Welding Alloys, Inc., 40 Worth St., New York, N. Y. These metals, available in a full range of special alloys in rod form, are said to make use of a new eutectic binding technique. Absolute fusion of molten rod with heated surface is claimed to be easily achieved.

"Durez 1910" Plastic Has High Impact Strength

Known as "Durez 1910," a high-impact phenolic molding compound developed by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y., is the third in a series of "1900" compounds having a particle size making it convenient to handle in hoppers and feeders.

Containing quantities of graphite this material was developed especially for such applications as bumper shoes, refrigerator lock bolts

for calculating Gearing within fixed limits of a Decimal and other uses!



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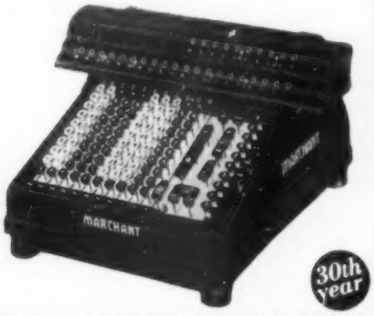

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It contains 120 pages of valuable data on all types of heating and heat-treating products, including: Blowpipes & Burners, Furnace Burners, Forges, Oven Furnaces, Pot Furnaces, Melters, Heating Machines, Blowers, Tube Furnaces and many others. This A.G.F. Catalog & Data Book also contains a section on accessories including: Pyrometers, Automatic Temperature Controls and Flow Meters.

A SPECIAL SECTION

of this free data book contains charts on S. A. E. Steels and Their Heat Treatment, a Temperature Conversion Table, a Hardness & Tensile Conversion Table, a Pressure Conversion Chart as well as other useful data.

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This Catalog & Data Book is offered on the "first come, first serve" basis.

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Representatives located in principal cities.

American Gas Furnace Co.
Elizabeth, New Jersey

and other parts where minimum frictional resistance is desirable.

Previous impact-resistant materials of this type have been of very fluffy consistency and were difficult to handle in feeders and hoppers. "Durez 1910" has a particle size comparable to dry rice and may be preformed easily. It flows freely through standard feeders. Specific gravity is 1.45. Bulk factor is 3.6:1.

Jessop "773" Tool Steel Possesses Unusual Toughness

A medium-carbon manganese-molybdenum steel, known as "773" tool steel, has been added to the line of cutting materials offered by Jessop Steel Co., 595 Green St., Washington, Pa. This steel is said to possess unusual toughness, making it suited for use in tools, dies, punches, cutting tools, chisels, etc., and for a variety of applications where exceptional toughness in thin sections, as in step-down dies, spatulas, scraper knives, etc., is required. A ¼-in. section in the hardened and drawn condition (58 Rockwell C) takes a permanent set without cracking or bending.

Bronze Welding Rod Has High-Test Flux

Air Reduction Sales Co., 60 E. 42nd St., New York, N. Y., has developed a high-test flux-coated bronze welding rod claimed to offer advantages of low fuming, faster application, denser deposit, increased tensile strength, greater bond strength, increased hardness, improved ductility and saving in time. It is claimed that this flux adheres well in shipment and in use, and that it will not fall off if the rod is bent excessively. For those who prefer a bare welding rod, the same flux is available in liquid paste form.

TRADE PUBLICATIONS

AIR CIRCUIT BREAKERS A 12-page illustrated catalog which lists and describes "De-ion" air circuit breakers for load center, panelboard, switchboard or inclosure mounting is circulated by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

AIR CLEANER Four-page folder, No. F-8501, published by Westinghouse Electric & Mfg. Co., Edgewater Park, Cleveland, describes the operation of the "Precipitron," an electrostatic air cleaner.

BLOWERS Roots-Connersville Blower Corp., Connersville, Ind., has issued a new bulletin, No. 21-B-35, which describes the construction and operation of rotary positive blowers for handling small and medium volumes of air against pressure or under suction.

COMPRESSORS Worthington Pump & Machinery Corp., Harrison, N. J., has published a 6-page folder which illustrates the operating features of roller bearing compressors for refrigeration.

CUTTING MACHINE Air Reduction Sales Co., New York, N. Y., has published an 8-page booklet which describes the operation and specifications of the "Radiagraph," a portable motor-driven gas-cutting machine.

CUTTING MACHINES Air Reduction Sales Co., New York, is circulating a 15-page booklet which describes the construction and operation of gas-cutting machines for marine construction.

ENGINES Caterpillar Tractor Co., Peoria, Ill., has just issued a 32-page booklet which lists the capacities and mechanical features of each of the eight sizes of Caterpillar diesel marine engines.

HOBBING MACHINES Barber-Coleman Co., Rockford, Ill., has published Bulletin No. F-1410-1, which covers special units and accessories for standard and precision hobbing machines.

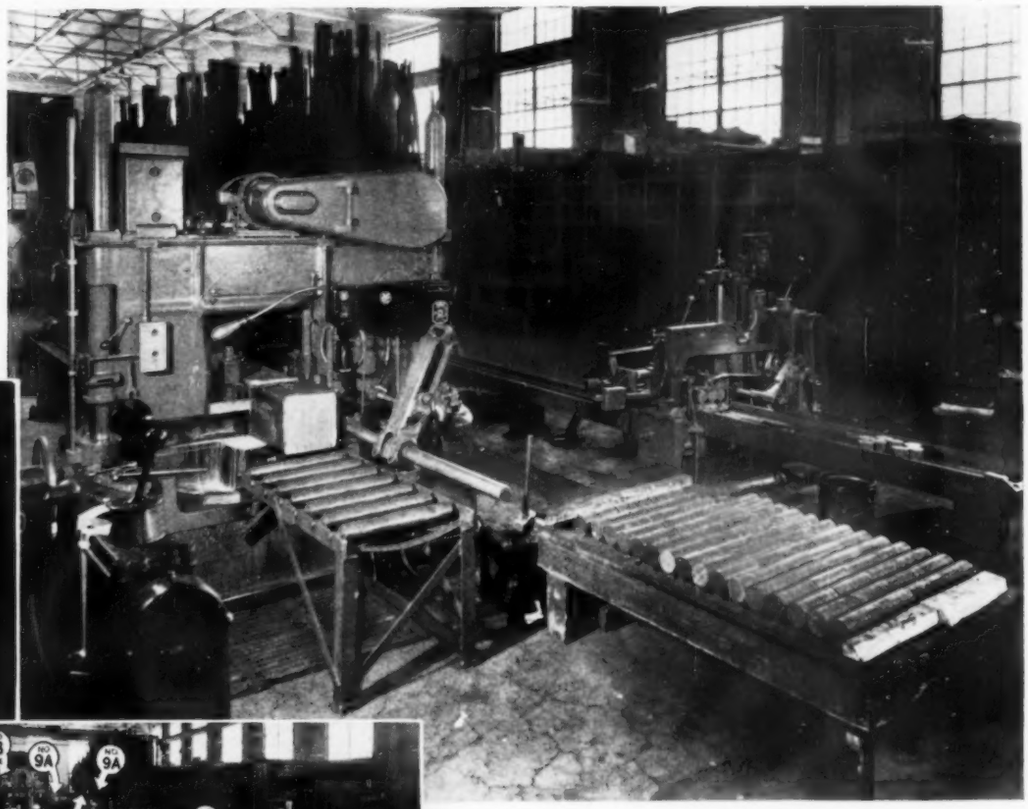
LIFTERS A 32-page catalog prepared by the Economy Engineering Co., Chicago, describes all types of lifting and hoisting devices for use in factories, warehouses, stores and machine shops. Details of construction are explained and sample specifications are given.

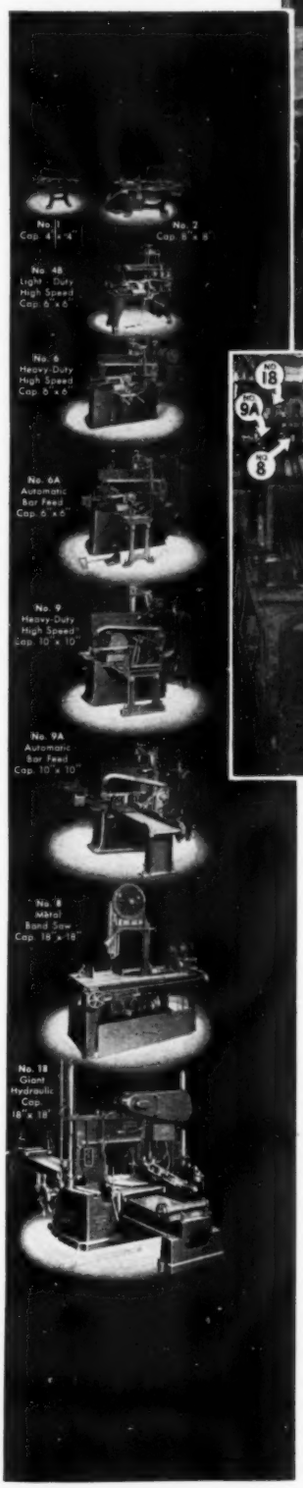
OIL CIRCUIT BREAKERS An 8-page illustrated bulletin, No. 33-600, circulated by Westinghouse Electric & Mfg. Co., contains a general description of oil circuit breakers designed especially for indoor industrial and central station use.

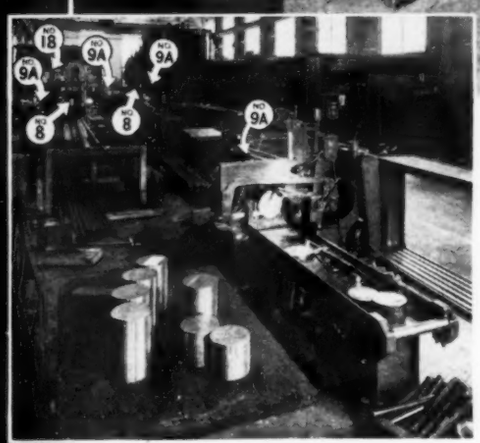
PRESSURE GAGES Brown Instrument Co., Philadelphia, has just published a new catalog, No. 6706, which covers a complete line of vapor-actuated thermometers and pressure gages.

PUMPS International Nickel Co., Inc., New York, N. Y., has just published an illustrated booklet containing comprehensive information on pumps and parts.

TURRET LATHES Jones & Lamson Machine Co., Springfield, Vt., has published a book, "Turret Lathe Earning Power," in which answers are given to fundamental questions that form a basis for comparison of turret lathes and their relative values.







MARVEL Saws help speed up National Defense at the Rock Island Arsenal

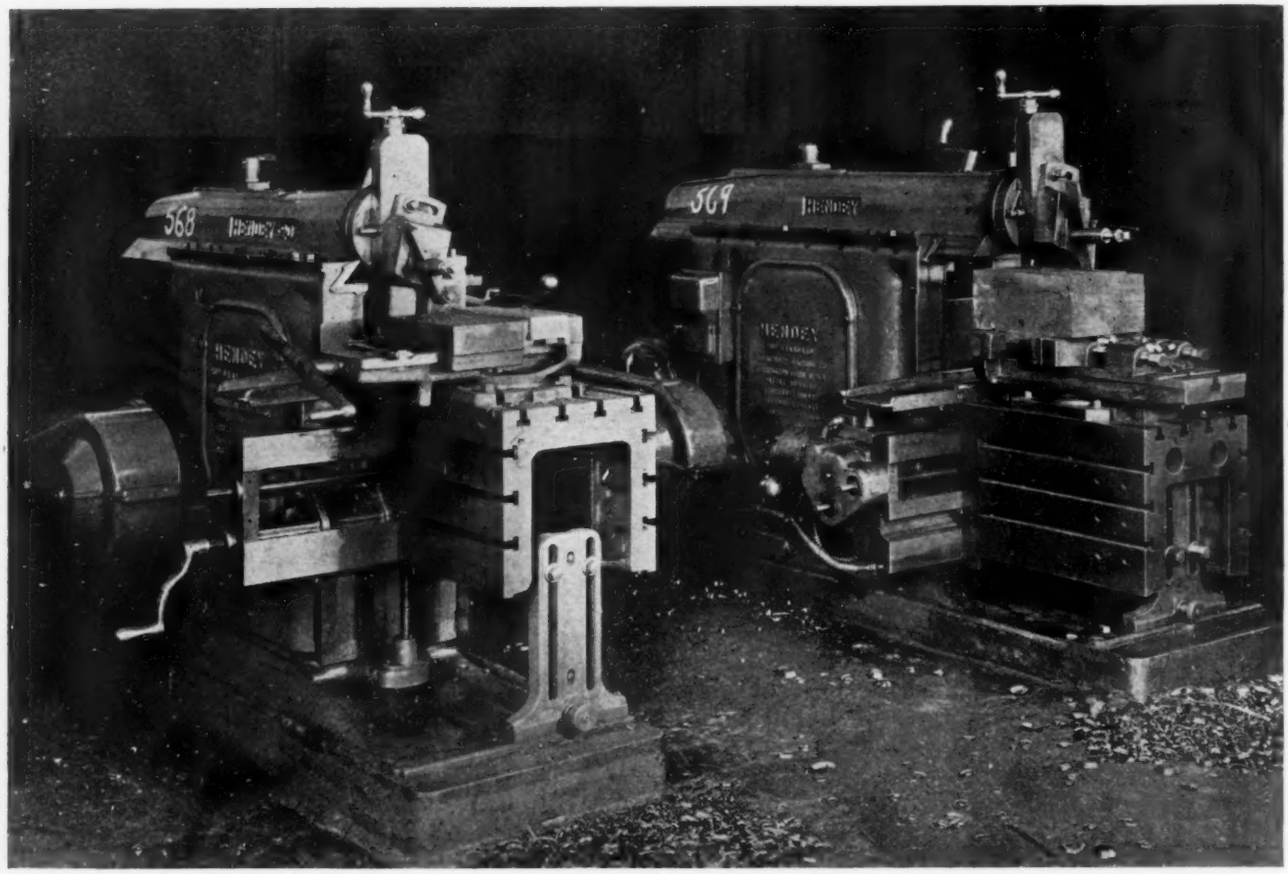
★ The bridge crane rolls down the bay, picks up a nest of long bars from the stock rack and lays them on the stock track of a MARVEL No. 9A. With the re-engagement of the automatic bar push-up, production is resumed, and accurately cut-off lengths again begin piling up at surprising speed. Meanwhile, another 9A is automatically cutting-off great slices from the 10-inch diameter bar. Down the bay, still other No. 9As are rapidly reducing long bars to accurately measured pieces. A second glance at the giant MARVEL No. 18 Hydraulic, shows it to be already deep in the large billet which was just moved into position, while nearby, two MARVEL No. 8 Metal-Cutting Band Saws are busy making a great variety of miscellaneous cuts in stock of all sizes and shapes.

There is a different atmosphere in this MARVEL equipped cutting-off department . . . none of the endless "plugging along" that one used to associate with hack sawing. Instead, smooth running, high-speed production . . . real output with modern high speed, all ball-bearing equipment. Because no other accurate cutting-off method can equal MARVEL SAWS in speed, dependability, or low cost per piece, they are being widely used in speeding-up the great National Defense Program.

MARVEL SAWS

ARMSTRONG-BLUM MFG. CO., "The Hack Saw People," 5700 Bloomingdale Ave., Chicago, U.S.A.
Eastern Sales Office: 199 Lafayette St., New York

HENDEY SHAPERS



HENDEY SHAPERS occupy positions of responsibility in many of the foremost shops in this country. They have established a reputation for being dependable.

Here are two HENDEY SHAPERS planing die blocks in one of the largest drop forge plants in the East.

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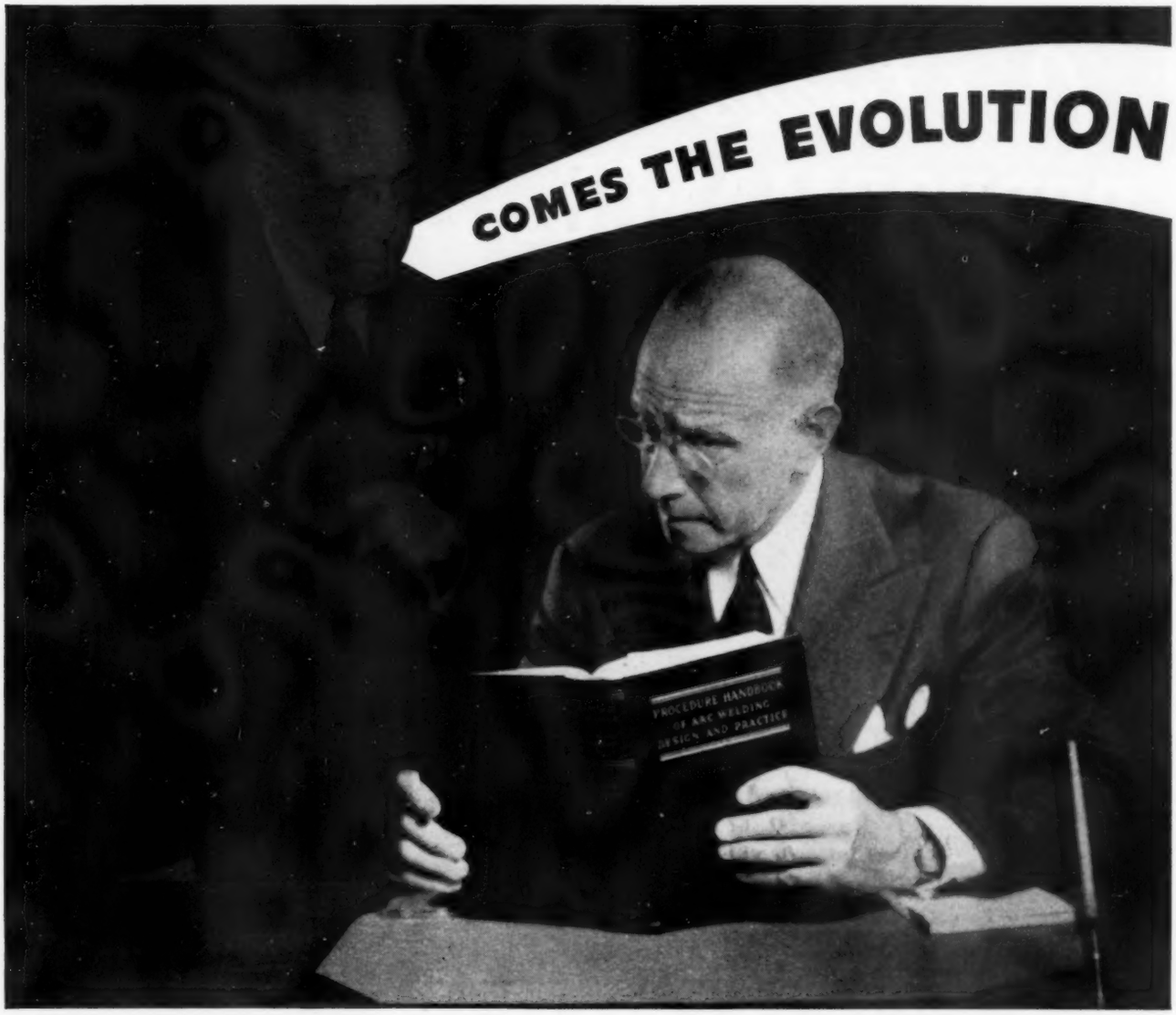

ALTER EGO: Literally "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

ALTER EGO: "Now pity a sorrier fate if you can: A vagabond soul in a stay-at-home man." Remember that poem?

Meaning what?

ALTER EGO: Meaning you're that way about arc welding. You'd like to improve your product and enjoy the saving in cost—BUT you'd rather sit comfy with the old familiar production process.

But we haven't the time *these days to change barrels while going over Niagara Falls.*

ALTER EGO: Then don't change barrels. The most rabid redesign enthusiast will tell you that redesign for arc welding is a matter of evolution, not revolution.

You mean we should do it one step at a time—like learning to walk?

ALTER EGO: Exactly, then when you've perfected the production of one part, take the second step —redesign the next part; and before you know it, you and the product are on the way to town.

• •

LINCOLN SUGGESTS: To the man who thinks he hasn't time or who doesn't know how to change over to welding, we offer this suggestion: See how others, with problems like your own, have started out with welded design. The booklet, "How to Changeover to Welded Design for Profits" (gratis) gives the evidence and a start.

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Authoritative Information on Design • Production • Welding Equipment

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PERFORMANCE *and* PRECISION

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Speed . . . flexibility . . . smooth action . . . precision production at full rated capacity—when you flood the work and the wheel with SUNOCO Emulsifying Cutting Oil.

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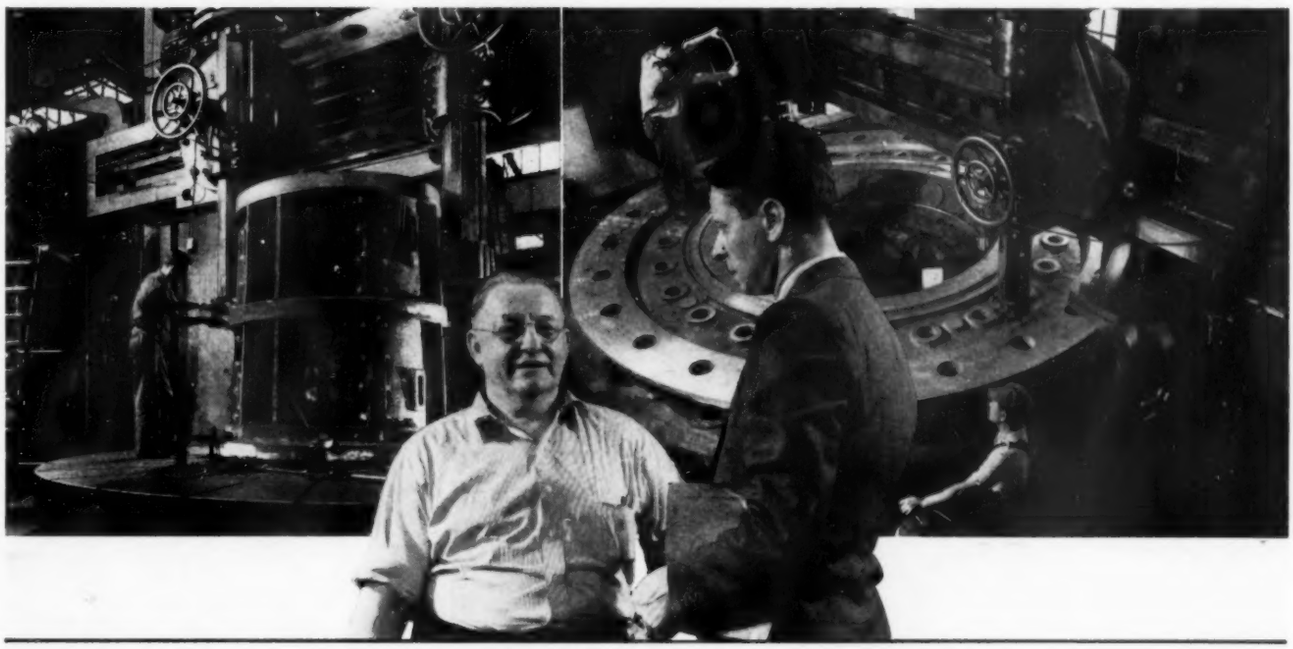
all our heavy equipment *performs better!*"

. . . says Plant Superintendent



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If you want the kind of lubrication that costs you least in the long run, ask a Gulf engineer to check your equipment and help you put into effect the modern practices that are saving money in many plants like yours.

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AMERCUT Bars are produced in a wide range of carbon steels and alloys which can be machined into an amazing variety of parts. The uniformity of these bars results in reduced wear on tools and economical production of parts that are accurate in all dimensions.

We are equipped to supply you with AMERCUT Bars in any type or grade and in the shape or finish best suited to your needs. Rounds are available in all sizes from 1/32" up to and including 6" and we will be glad to furnish you with full information on special sizes and shapes.

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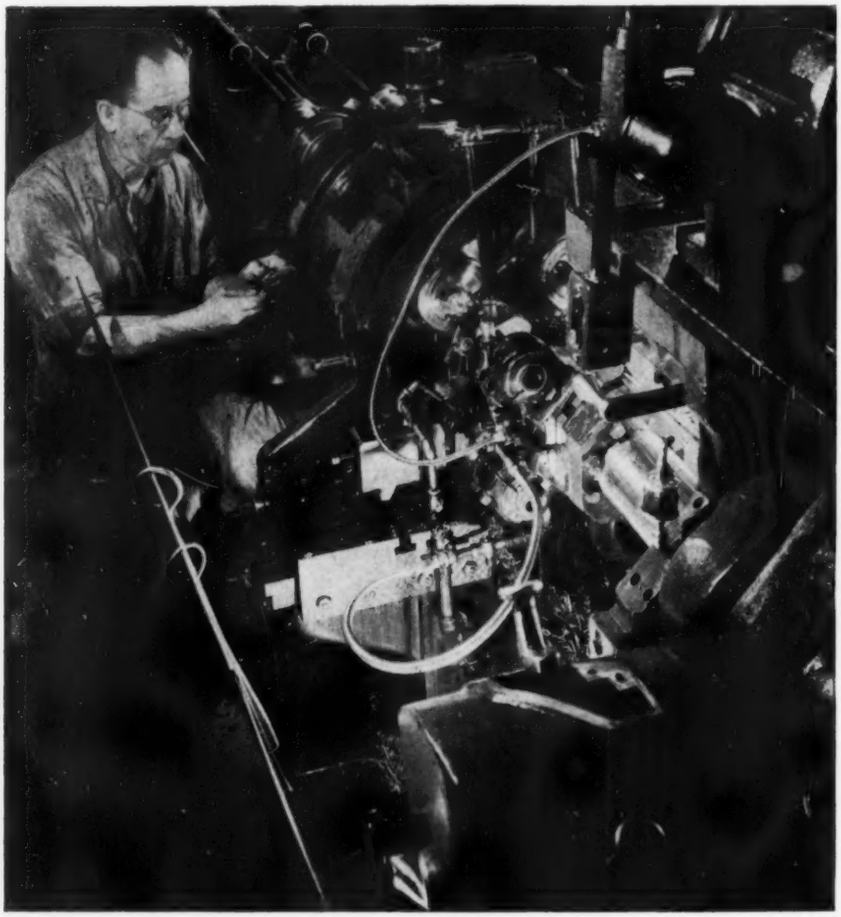

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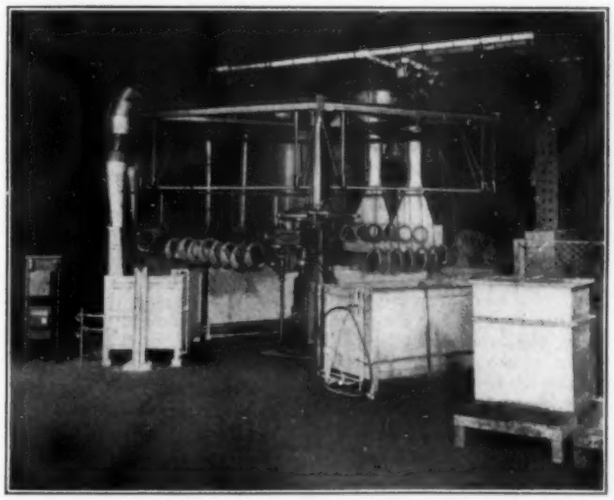

A Bullard-Dunn Process Station Type Conveyor Installation.

THE BULLARD-DUNN PROCESS DIVISION

The Bullard Company

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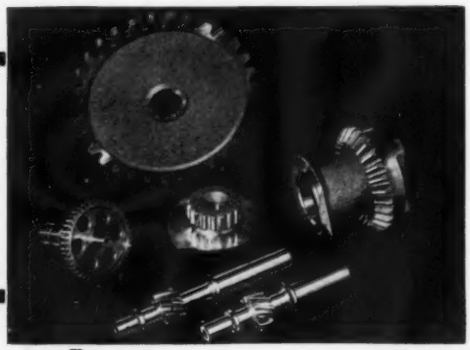
for *Precision* requirements



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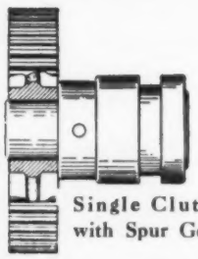

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Our experts have engineered into the Johnson Clutch a responsiveness far beyond anything you have ever known in clutch usage. Their smooth action in picking up the load—their dependable service in carrying overloads without slipping or vibration—assure long life and low maintenance cost; not only for the clutch itself but for the entire machine to which it transmits power.

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Write for 1940 Blue Clutch Catalog No. 124 covering expanding ring clutches and our literature covering the "Maxitorq" floating plate disc type.

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18 other styles of Janette reducers are available.

This style of reducer is especially well adapted for driving thread millers, gear hobbers, punch presses, shears, key-seaters, planers, etc. It is easy to mount—requires small space—gear head can be rotated 360°.

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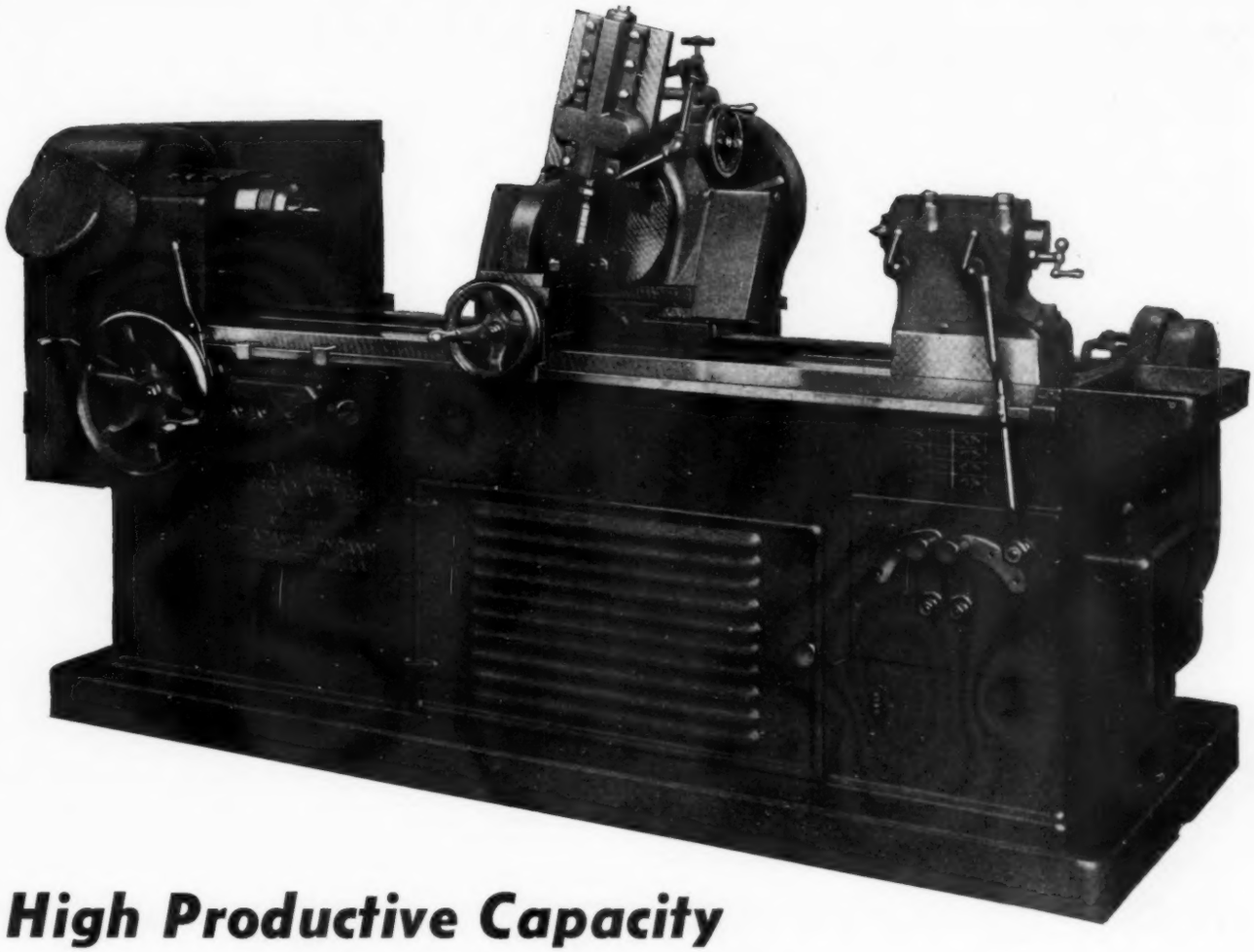

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Spur gears, helical gears, splined shafts, sprockets, ratchets and multiple threaded worms can be handled most economically by the hobbing method.

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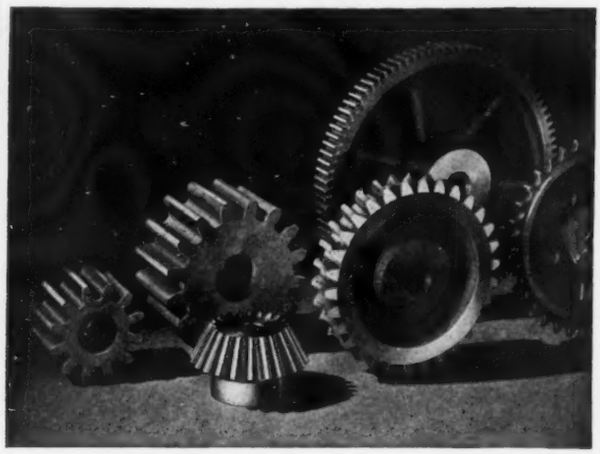

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"Whether your drawings call for standard or special Gears, you will find Grant Gears will give you the high efficiencies and economies that present-day requirements demand."

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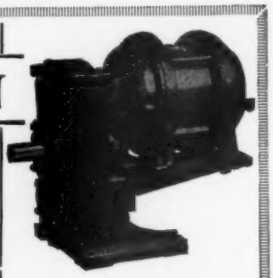

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Equipped with Timken Bearings and Helical Gears. Made in sizes for motors from ¼ to 15 hp. Ratio from 2½ to 1 to 1014 to 1.

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10 to 64 D.P.

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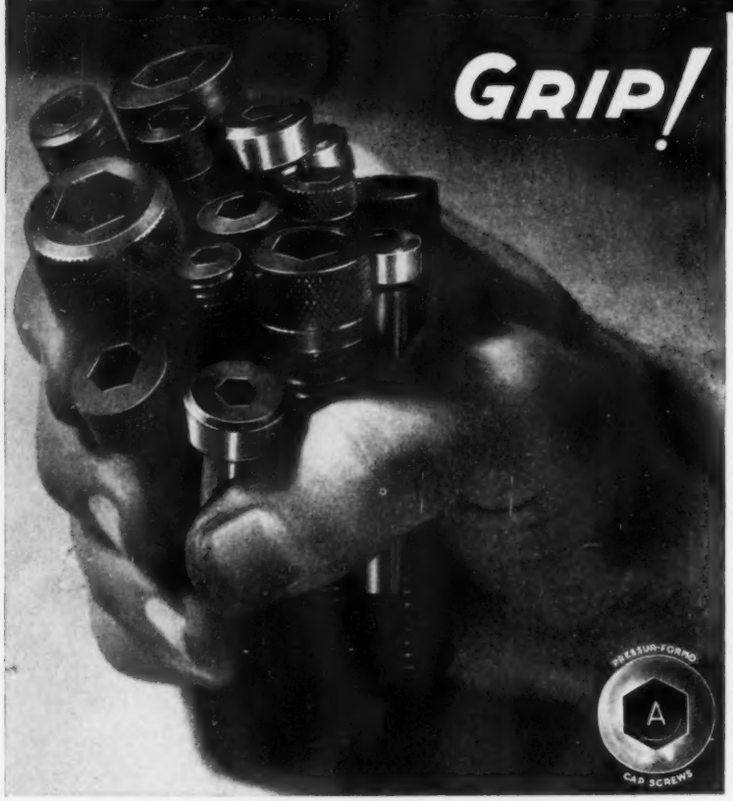

MANAGEMENT'S grip tightens on the tools of production; engineers bear harder on speeds and stresses; machines are racked by the reckless strains of emergency operations.

But *ALLENS* HOLD. They are "steeled" to hold, threaded to hold, hardened to hold. The technical history of their development is three decades of TESTS — *duplicating emergency conditions.*

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HARTFORD, CONN., U. S. A.

WELCO

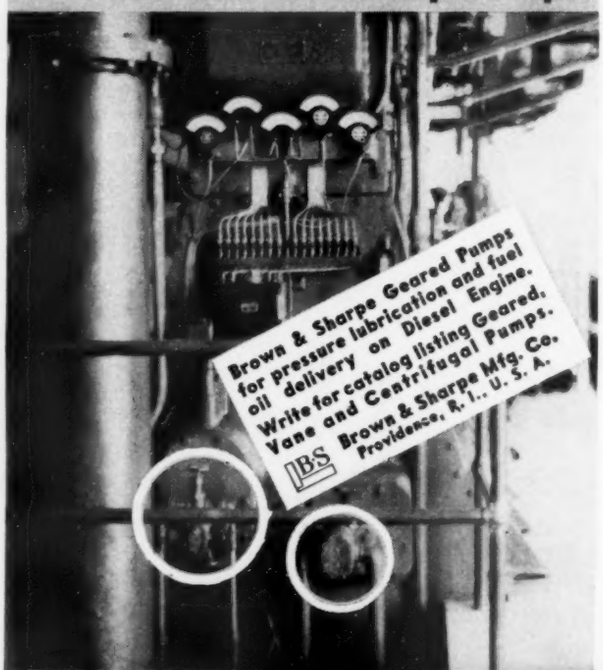
TORQUE MOTORS ENHANCE DEPENDABILITY

WHEN MADE A PART OF YOUR MACHINE, BY PROVIDING SIMPLE RUGGED CONSTRUCTION.

ASK A USER OF WELCO TORQUE MOTORS

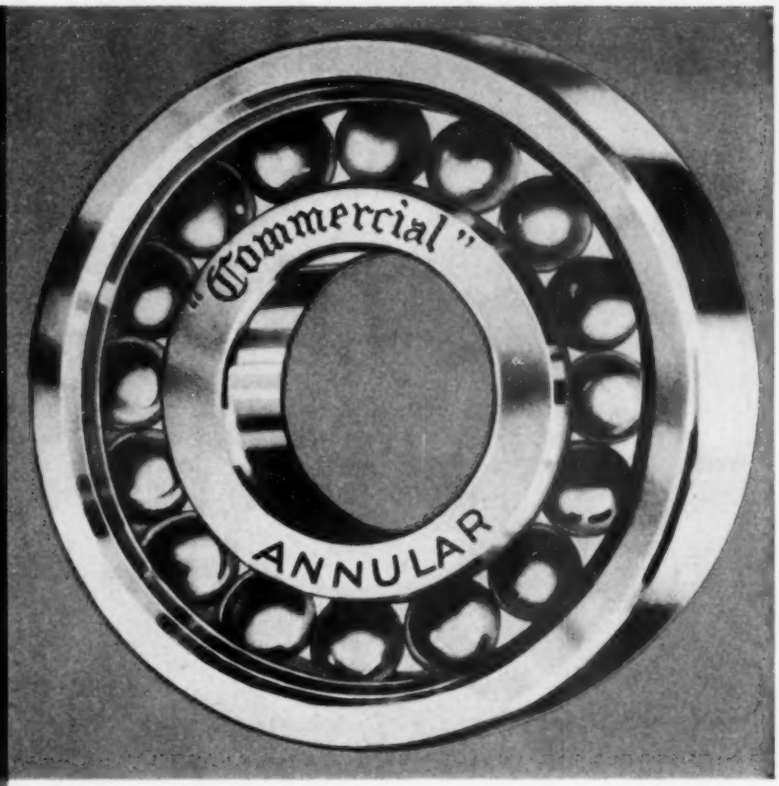
THE B. A. WESCHE ELECTRIC COMPANY
CINCINNATI, OHIO

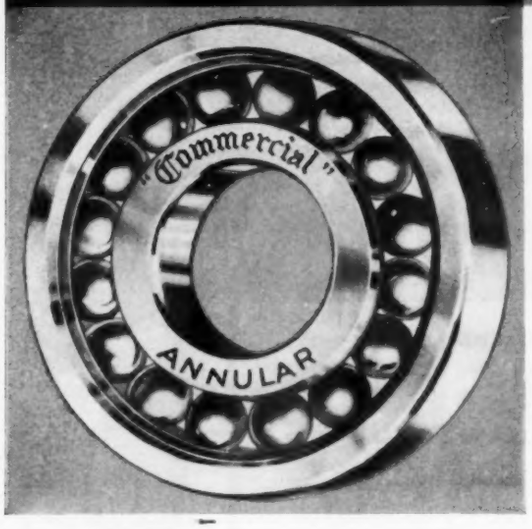
Where Dependability is Vital — You'll find Brown & Sharpe Pumps


Brown & Sharpe Geared Pumps for pressure lubrication and fuel oil delivery on Diesel Engine. Write for catalog listing Geared, Vane and Centrifugal Pumps.
Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.
BS

BROWN & SHARPE PUMPS

Accuracy and Precision





"Commercial"

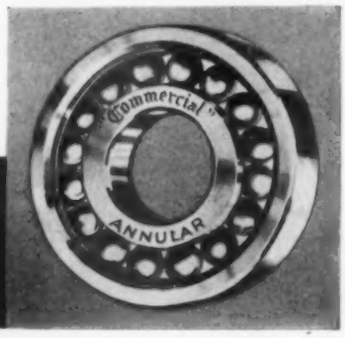
ANNULAR

BALL BEARINGS

THESE highly efficient bearings are manufactured with the most exacting care by ball bearing experts. Accuracy and precision are outstanding characteristics of all **"Commercial"** Annular Ball Bearings and, for this reason, are preferred by those who demand quality and efficiency.

THERE is no job too difficult for **"Commercials"**. They stand up under the most gruelling service conditions. Overloads and side-thrusts are easily sustained. Speeds up to 2500 R.P.M. with dual thrust capacity. High grade steels, carefully heat-treated, assure long life and uninterrupted performance, plus economical operation.

OUR Engineering Staff will be pleased to assist in making recommendations regarding the *correct* type of bearing for any product you make, or any machine you operate. Write for complete information and latest catalog.



THE SCHATZ MANUFACTURING CO.

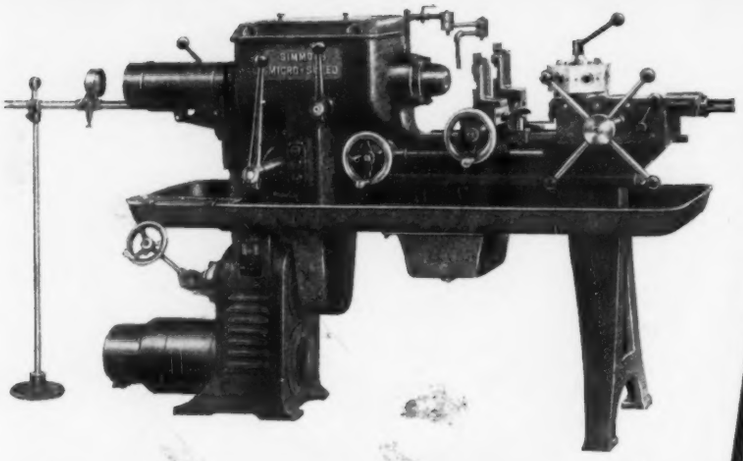
POUGHKEEPSIE, N. Y.

Detroit Sales Office: 2608 Book Tower • Chicago Sales Office: 902 S. Wabash Ave.

Cleveland Sales Office: 402 Swetland Building

QUICK DELIVERIES ASSURED!

SIMMONS
NO. 2 TURRET SCREW MACHINE



MICRO-SPEED-DRIVE*

This sturdy machine (1¼" capacity) offers unusual quick-production advantages. It has been especially designed with every modern facility for rapid, accurate output.

The greatest possible rigidity is assured as the head is cast solid with the bed. The spindle, mounted on Timken precision tapered roller bearings, is of high carbon steel and accurately ground to size. Levers are within immediate reach of the operator.

*The patented SIMMONS *Micro-Speed Drive*, equipped with push-button control and magnetic brake, offers a range of spindle speeds up to 1,500 RPM. With this drive, the operator can immediately select by a mere turn of a handwheel the best-suited spindle speed for the class of stock to be machined.

• • •

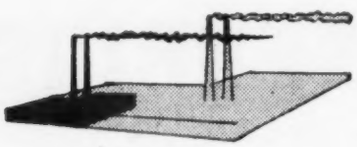
Write today for complete specifications.

• • •

LOW COST

SIMMONS MACHINE TOOL CORPORATION

Main Office: 1759 North Broadway, Albany, N. Y.
Export Office: 149 Broadway, New York City



WE'VE INCREASED OUR PLANT BY 4 TIMES SINCE 1935 — BECAUSE AMERICAN INDUSTRY IS CUTTING COSTS WITH UNIVERSAL DRILL BUSHINGS

American Industry is more and more specifying Universal drill bushings because: (1) they have superfinished bores, straight and round within .0001; (2) unexcelled wearing qualities; (3) rust-proof black domes; and (4) nickle-steel, cadmium plated lock screws. Available in all ASA standard sizes. Write for facts.

UNIVERSAL ENGINEERING CO.
FRANKENMUTH, MICHIGAN

CUP DISC FAN
PROTECTS MOTOR WINDINGS

RUTHMAN GUSHER COOLANT PUMPS

A patented cup disc fan built into the upper part of the motor prevents oil or dirt from getting on the motor windings — just another reason why you can expect long and efficient service from Ruthman Gusher Coolant Pumps. Gushers can be throttled to any speed without building up pressure, and they can handle cutting fluids containing grit without danger of injury.

Write for complete data sheets and see for yourself why Ruthman Gusher Coolant Pumps are so popular.

Flange - mounted type with internal discharge. Other types include: Immersed Types, Pipe Connected Types, Plain Drive Types and Tank Units. There is a Ruthman Gusher Coolant Pump to meet your needs.

THE RUTHMAN MACHINERY CO.
201 PIKE ST., CINCINNATI, OHIO
LARGEST EXCLUSIVE BUILDERS OF COOLANT PUMPS

LEWIN-MATHES *decided to*

"Ask ETNA about Swaging"

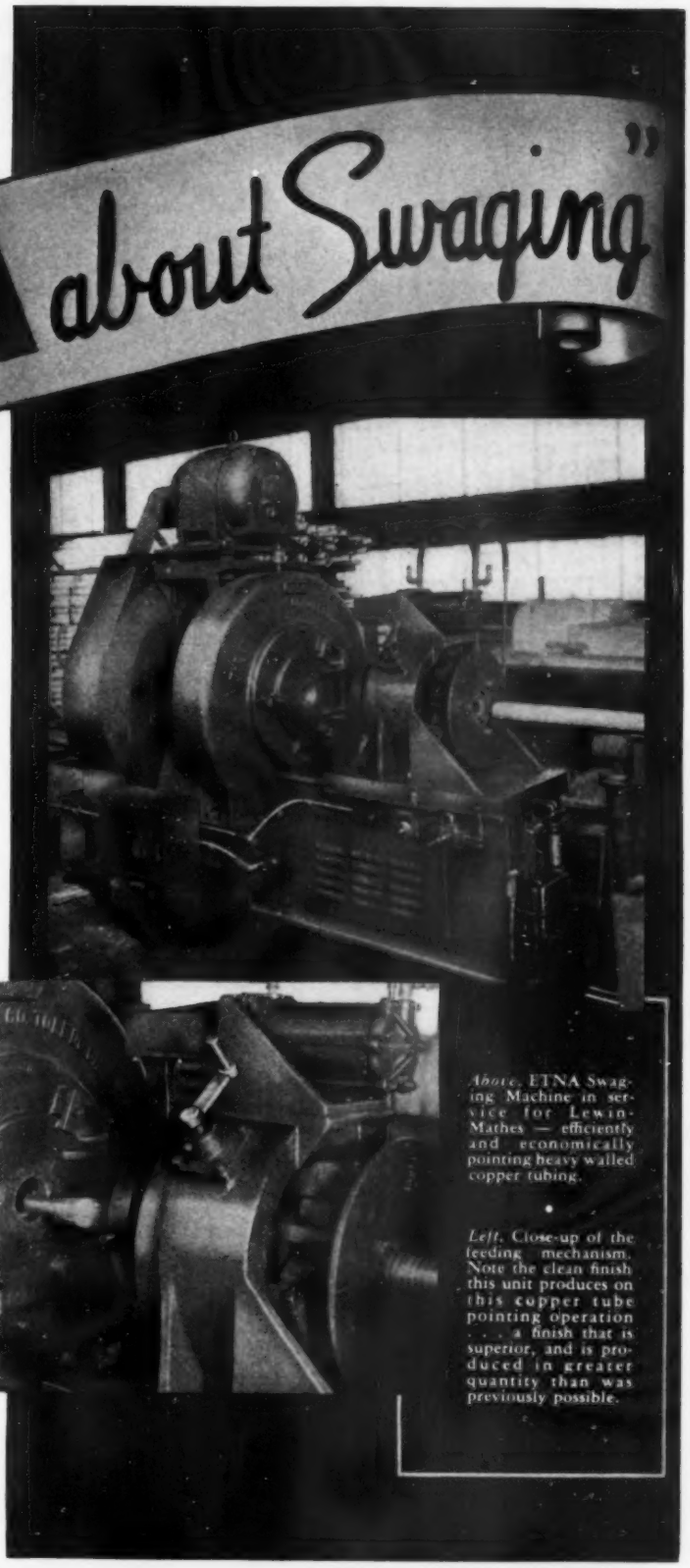
. . . NOW THEY'RE POINTING TUBES FASTER AND BETTER

with this

Etna Swaging Machine

Pointing tubes . . . *and pointing more of them* . . . oftentimes presents a problem, as it did at Lewin-Mathes. Increased production, without increased cost, was the "order-of-the-day." So, they "asked ETNA about swaging," and achieved two-fold benefits. They *pointed more tubes,* and at the same time, got a better quality job at lower cost. This case is but one example of countless ETNA installations that have added speed and quality to the tapering, sizing and reducing of round solids or tubing in the country's most efficient plants.

ETNA Swaging Machines' basic construction features are proof enough of *why* they can do better work at reduced cost! Where properly applied, ETNAS' are capable of reducing the use of preliminary machinery . . . sometimes even eliminating it altogether! You'll find it pays to consult ETNA about swaging. Their experience in solving problems for other prominent manufacturers can be of infinite value in helping *you* to lower production costs. ETNA swaging machines are built in capacities of $\frac{3}{8}$" to 4", with die lengths of 1" to 18". Don't hesitate—"Ask Etna About Swaging" *today!*



Above. ETNA Swaging Machine in service for Lewin-Mathes — efficiently and economically pointing heavy walled copper tubing.

Left. Close-up of the feeding mechanism. Note the clean finish this unit produces on this copper tube pointing operation . . . a finish that is superior, and is produced in greater quantity than was previously possible.

IF IT'S A QUESTION OF TAPERING, SIZING OR REDUCING OF ROUND SOLIDS OR TUBING . . .

"Ask ETNA About Swaging"

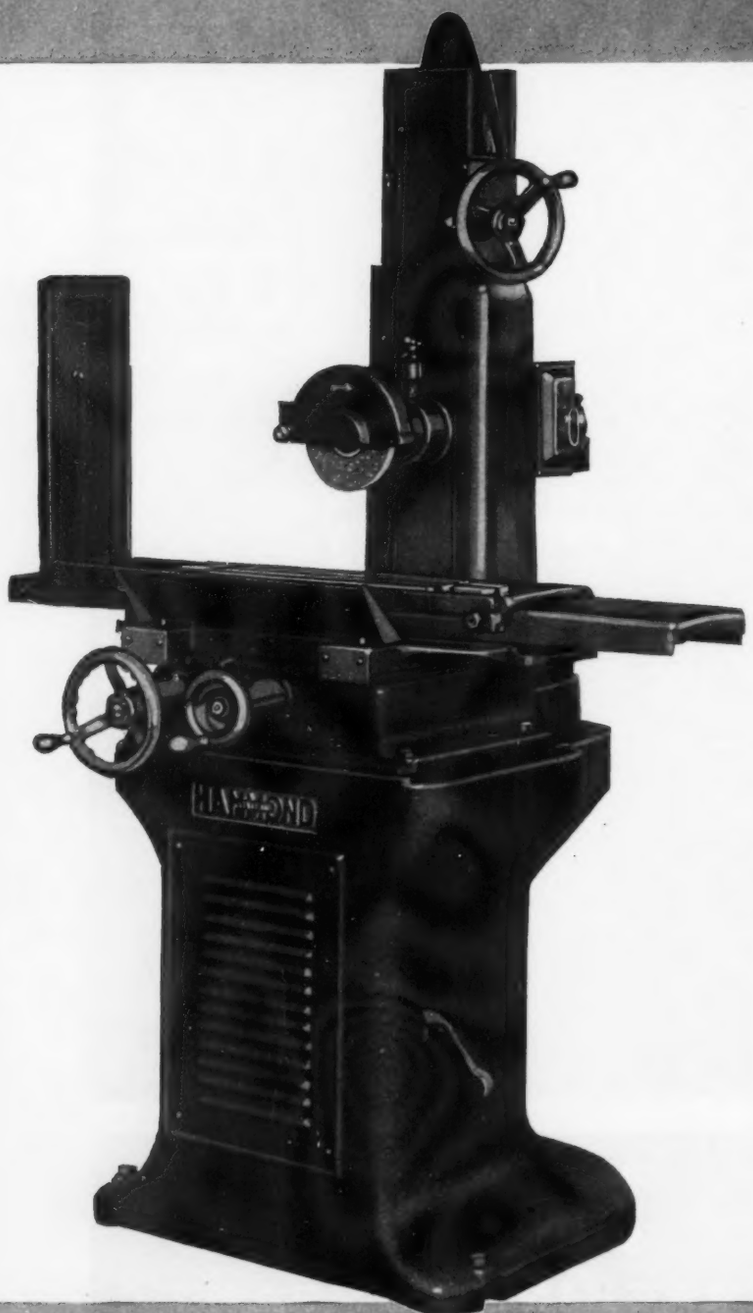
ETNA

MACHINE COMPANY

TOLEDO OHIO

Announcing . .

that we have broadened our line by acquiring The Hammond Manufacturing Co.



No. 2 SURFACE GRINDING MACHINE

- A hand-feed tool-room grinder of sturdy construction and high precision. Greatly valued for fine tool and gauge work.

FOOTBURT

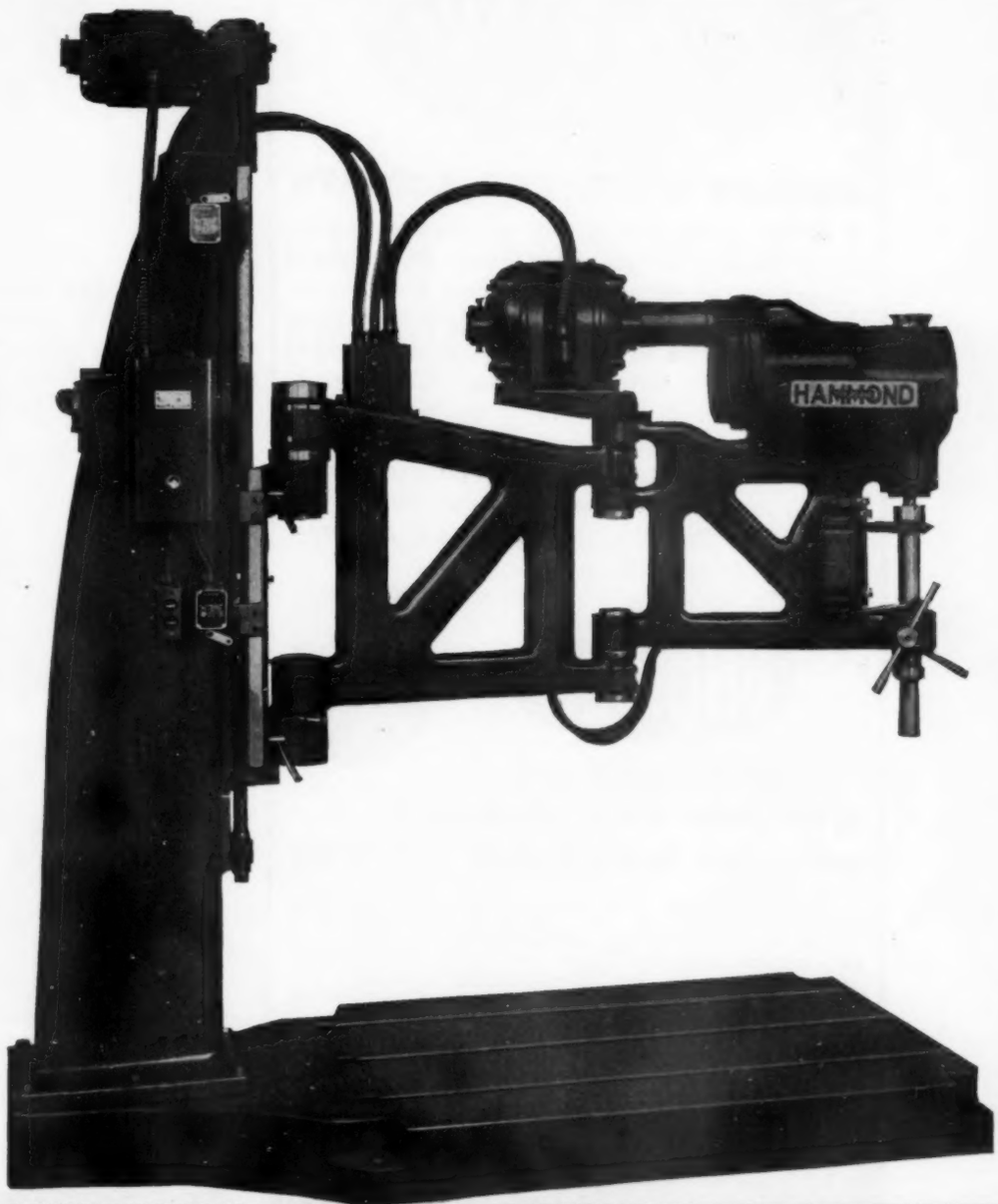
THE HAMMOND MANUFACTURING CO.

CLEVELAND, OHIO

• These machines will still be manufactured by Hammond and retain the name Hammond.

TYPE G RADIAL DRILLING MACHINE

• A sensitive feed spindle for fast handling over a large layout of holes. Six quick speed changes with tapping mechanism for a wide range of hole sizes.



Now owned by

THE FOOTE-BURT CO.

CLEVELAND, OHIO

FOOTBURT

The Knurled heads make a DIFFERENCE

UNBRAKO

REG. U. S. PAT. OFFICE

SOCKET HEAD CAP SCREWS

● When your production is rushed, when every second counts, you'll find this unique "Unbrako" advantage a real time and money saver. For just as the winding stem of your watch is knurled to prevent slip, so is the cold-forged "Better-Grip" "Unbrako" Cap Screw. Fingers get a slipless grip in setting up, turn the screw faster and farther before applying wrench. In addition up-to-the-minute alloys, skilled heat treating and precision give to all "Unbrako" Products strength and accuracy that defy comparison.

UNBRAKO

Pat'd.

SELF-LOCKING HOLLOW SET SCREWS with the KNURLED POINTS

● Just set them up with no more than ordinary pressure and the knurled cup points automatically lock into place with a lasting, vibration-defying grip . . . a grip that prevents the frequent and expensive troubles caused by ordinary set screws failing to hold. Yet "Unbrako" Self-Lockers are easily applied or removed, and they may be used any number of times. For these money and trouble saving advantages, be sure to specify "Unbrako."

Ask your distributor or write—

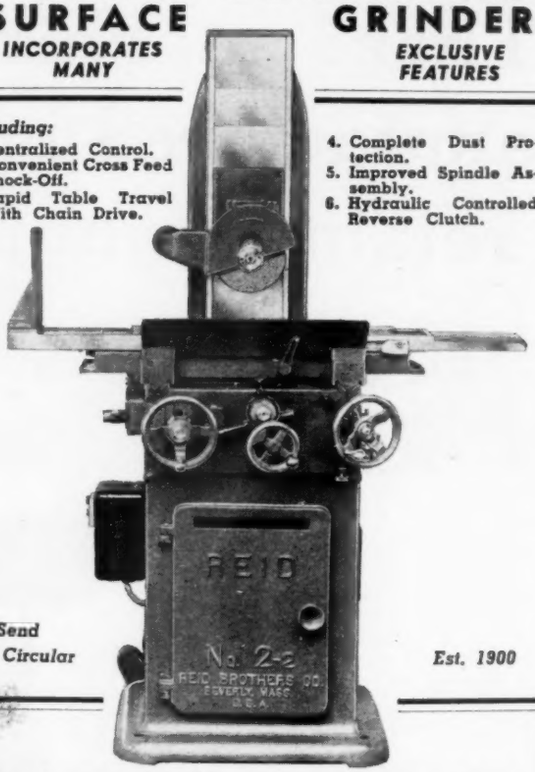
STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. BOX 4
BOSTON · DETROIT · INDIANAPOLIS · CHICAGO · ST. LOUIS · SAN FRANCISCO

THE REID POWER-FEED SURFACE GRINDER

INCORPORATES MANY EXCLUSIVE FEATURES

Including:

1. Centralized Control.
2. Convenient Cross Feed Knock-Off.
3. Rapid Table Travel With Chain Drive.
4. Complete Dust Protection.
5. Improved Spindle Assembly.
6. Hydraulic Controlled Reverse Clutch.

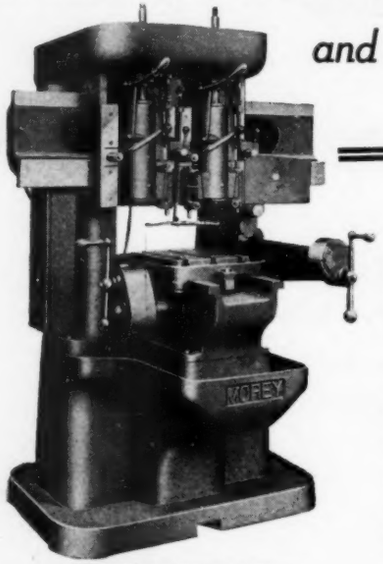


Send For Circular

Est. 1900

REID BROTHERS COMPANY, INC.
Beverly, Massachusetts

MOREY No. 12M HIGH SPEED VERTICAL PROFILER and MILLER



Production of inter-changeable parts requiring milling of any contour or outline can be materially speeded up by this Profiling and Milling Machine.

CONDENSED SPECIFICATIONS

Table working surface—12¾x15¼
Table travel—longitudinal—23"
Table top to bottom of cross slide: maximum: 11⅛"; minimum: 7½"
Table top to spindle end: minimum 4"; maximum 8 to 12"
Single spindle machine can also be furnished.

"Ask for descriptive bulletin."

MOREY MACHINERY CO., INC.
410 Broome Street New York, N.Y.

This ARTER *in action*

CUTS TIME FROM 15 MINUTES TO 5 MINUTES

FOR A LEADING MACHINE TOOL BUILDER

Time savings of such outstanding importance today in machine tool production are combined with highly accurate work by this Arter Model A-3-12 Rotary Surface Grinder in the shops of a nationally known builder of modern machine tools.

The parts being machined are cast iron spacers for ball bearing work head for a widely used internal grinding machine. Part dimensions are as follows: inner spacer 6¼" O.D. x 5" I.D. x 5" long; outer spacer 11" O.D. x 9¾" I.D. x 5" long. Tolerance specifications called for and being maintained are 5.000 ±.001 on thickness and .0001 on parallel. Production: 12 pieces per hour; finish, very good. Each pair of spacers must be parallel and equal in size within .0001.

Since putting this ARTER-in action, time has been reduced from 15 minutes to 5 minutes per pair.

This speed up in production is being achieved with such simplicity of operation that it is not necessary to have a highly skilled operator assigned to handle the job.

An Arter-in ACTION on your production will enable you, too, to maintain close accuracy at top speed on surface grinding operations.

MODERN FEATURES CONTRIBUTING TO MAINTAINED SPEED, ACCURACY AND ECONOMY

Arter Rotary Surface Grinders—built in 8" and 12" light duty and in 12" and 16" heavy duty types are of extremely rigid construction throughout. Rigid housing for wheel spindle, together with generously proportioned spindle bearings insure vibration-free performance and long service life. Work table has great vertical capacity and rigidity in all positions.

Illustrated bulletins are available fully describing these and many other outstanding features.

ARTER
GRINDING MACHINE CO.
Worcester, Mass., U.S.A.

A Year-Round Reference *for the* Production Man in a *Hurry*

This year manufacturing executives are calling for *action!* Buying decisions are being made by men in a hurry.

To meet expanded requirements for equipment, supplies and materials, you may be seeking additional suppliers, and that means that more than ever you will find *American Machinist's* 28th Annual Review & Catalog Number of tremendous value. Eight big sections —with editorial and advertising pages classified for easy reference—will give you *extra* help when you need it most. Watch for this issue. Hold it for year-round use!

AMERICAN MACHINIST

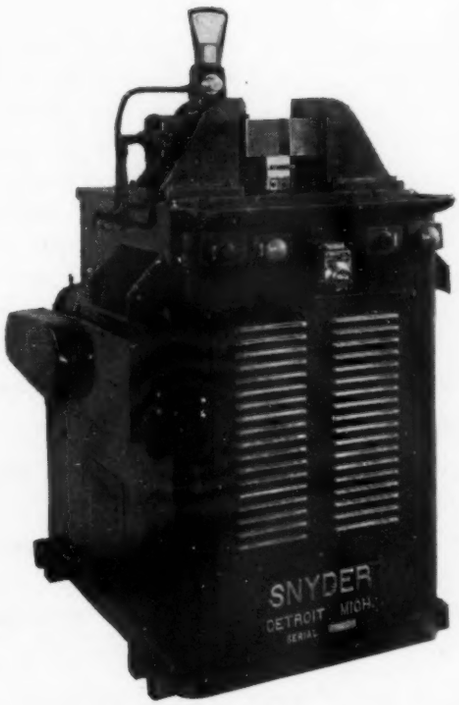
28th ANNUAL REVIEW AND CATALOG *Number*

JAN. 22, 1941

Coming to You in Four Weeks

HOW CAN WE GET FASTER, MORE ACCURATE PRODUCTION for the DEFENSE PROGRAM?

. . . HERE ARE TWO ANSWERS FROM SNYDER



Defense contracts mean increased production on both standard and new designs . . . and this greater output *can* be achieved with a minimum of outlay for new equipment by choosing SNYDER special machines.

Here are two units designed and built to lower costs wherever used . . . both do specific jobs—rapidly, accurately and automatically.

Our engineering department is eager to submit proposals on those operations that you feel can be speeded . . . where cost per item can be lowered. Call on us . . . with a description of your problem, we'll provide plans and prices free of charge.

Remember . . . for assured low-cost production on new design,

SNYDER FITS THE MACHINE TO THE JOB!

Above. This Snyder Balance Milling Machine mills pistons to exact weight — *automatically.* Only human element consists of operator's adjusting piece in holding clamp. Assures accuracy, and at the same time adds to number of units milled per hour!

Right. This Snyder Profile Milling Machine contour mills aircraft engine rods complete in 30 min., also suitable for articulated rods and similar contour milling operations by merely changing master cam.

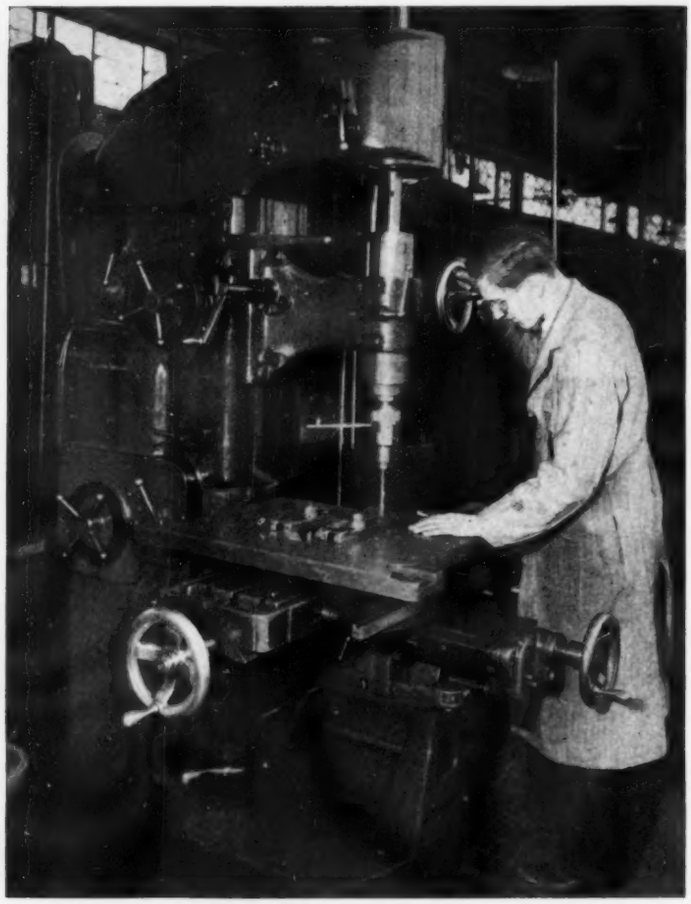
SNYDER TOOL & ENGINEERING CO.

DESIGNERS AND BUILDERS OF SPECIAL MACHINERY

3400 E. LAFAYETTE ST. DETROIT, MICH., U. S. A.

ALL JIG FIXTURE AND TOOL ROOM BORING FOR PROSPERITY CO., SYRACUSE, N. Y. DONE ON A

KNIGHT MILLER NO. 40



★ In addition, the Prosperity Company, manufacturers of automatic laundry and dry cleaning machines, uses the Knight Miller No. 40 for all of its milling, particularly all parts that have to be undercut or cut on an angle—and they also use this modern milling machine for facing and grooving operations.

Tolerances on this work may range from 1/64" to .0000".

All this indicates two important things—that the Knight Miller insures accuracy and that it offers real versatility. The Knight Miller makes better operators of your men—it answers the need for greater speed—it machines difficult and unusual parts quickly and accurately without special equipment—it does a wide range of ordinary plain milling, boring, and facing work.

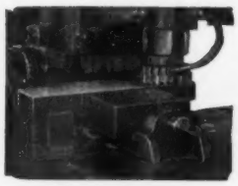
Some of the features that help you improve production

1 Quick vertical adjustments are easy with the counter-balanced spindle head.

2 Ease of making tool changes and centralized easy-to-use controls simplify operation.

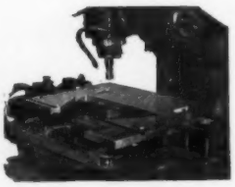
3 Dial indicators give you quick and accurate locating.

SOME OF THE REASONS WHY THE KNIGHT MILLER CAN BE A PROFIT-MAKER FOR YOU . . .



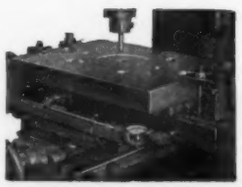
Timken mounted spindle and accurately fitted rigid table furnish power and accuracy for this face milling cut.

Ease of operation, quickly changed cutters, quick reading dials provide for efficient milling operations on this 20"x25" steel plate.



Power and rigidity permit heavy milling like taking 3/4" off the 5" face of steel forgings by a 2"x6" helical cutter.

Boring operations on this 29"x18" plate get accuracy and speed from dial indicators, accurate spindle and square table slides.



Send FOR OUR THREE INFORMATIVE BULLETINS

Read the important facts about the Knight Miller No. 20, 30 and 40—each of these three is described in a separate bulletin that points out the advantages of a Knight Miller—no obligation on your part by sending for these bulletins—we simply want you to know the important Knight Miller story.

KNIGHT VERSATILE MILLERS ACCURATE • RIGID

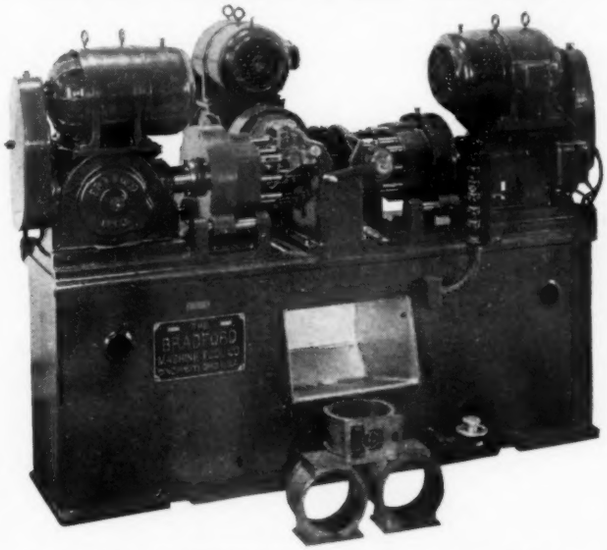
W. B. KNIGHT MACHINERY CO.
• ST. LOUIS, MISSOURI •

THE SIMPLEST WAY TO SOLVE COMPLICATED DRILLING AND TAPPING PROBLEMS...

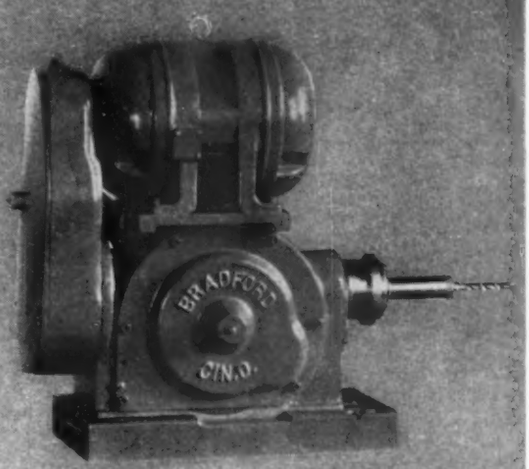
BRADFORD
UNIT-TYPE
SELF-CONTAINED
SINGLE OR
MULTIPLE SPINDLE
HEADS

For Instance—

32 No. 23 HOLES IN A CAST IRON METER . . . 240 PARTS PER HOUR!



● Typical of the hundreds of production problems solved by specially designed machines incorporating any reasonable number of *Bradford Drilling and Tapping* Heads is the one shown here, developed in collaboration with the engineers of a leading meter manufacturer. Electrically controlled through the use of convenient push buttons right at the operator's fingertips, three independently driven heads, two with eleven spindles and one with ten, negotiate all 32 of the holes required in one operation . . . and almost as fast as you can say, "Here's production efficiency I might well investigate". Available in a range of sizes and with either single or multiple spindles, we offer you the "makings" of a machine with which to meet nearly any production requirement involving drilling, reaming, hollow milling, spot facing, tapping, etc., or any combination of these various operations.



BRADFORD SINGLE SPINDLE DRILLING UNIT

●

Unit same as above can be furnished for tapping . . . is of the electric reversing motor type

●

LET US KNOW YOUR PROBLEM . . . WE'LL FIGURE A WAY TO SOLVE IT!

Our engineers have had plenty of experience ironing out complicated production problems, so as to simplify the operation, increase capacity, and reduce per-piece-cost. Why not send us a sample (or blueprint) of one of your more troublesome parts and let us estimate on how much better and faster you can machine it with *Bradford Unit-Type Heads*? There's no obligation, so you've got everything to gain!

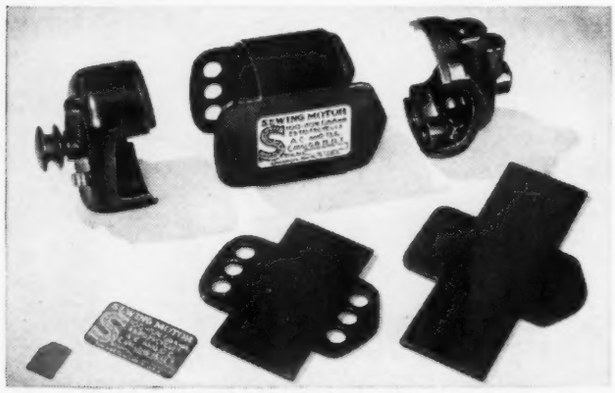
THE BRADFORD MACHINE TOOL CO.
CINCINNATI, OHIO
MAKERS ALSO OF BRADFORD GEARED HEAD LATHES

PRECISION TOOLS
SINCE 1840
DEALERS WANTED
IN SOME TERRITORIES

Sturdy thin-wall housing successfully obtained with combination of BAKELITE Plastics

THE Diehl Manufacturing Company employed a combination of three BAKELITE Plastics to obtain a sturdy, compact, and safely-insulated housing for the Singer sewing machine motor.

A general-purpose molding material was used for the end-plates while two BAKELITE molding blanks provided the necessary impact strength for the thin-walled housing. Thus, the manufacturer was able to replace a metal housing without going to much heavier sections and without sacrificing shock-resistance. The molding process also made it possible to incorporate the famous red "S" trade mark—cut from paper coated with pigmented heat-reactive BAKELITE varnish—and the metallique name-plate as an integral part of the housing.



Disassembled view, showing both the motor-ends formed from a standard-type BAKELITE Molding Material, and the two BAKELITE Molding Blanks from which the housing in the center is formed. At lower left are the metallique name-plate as well as the BAKELITE Varnish-coated paper used to supply the red trade mark.

BAKELITE Molding Blanks are used for numerous other applications where resistance to impact is desired at low cost. Furnished in disc, rings, rectangles, and squares in varying thicknesses, they may be used alone or in combination with regular molding materials to provide reinforcement at vital points.

BAKELITE engineers will be glad to work with you in adapting these blanks and other BAKELITE Plastics to your particular needs. Write for specific details on BAKELITE Molding Blanks and request, also, Portfolio 2.

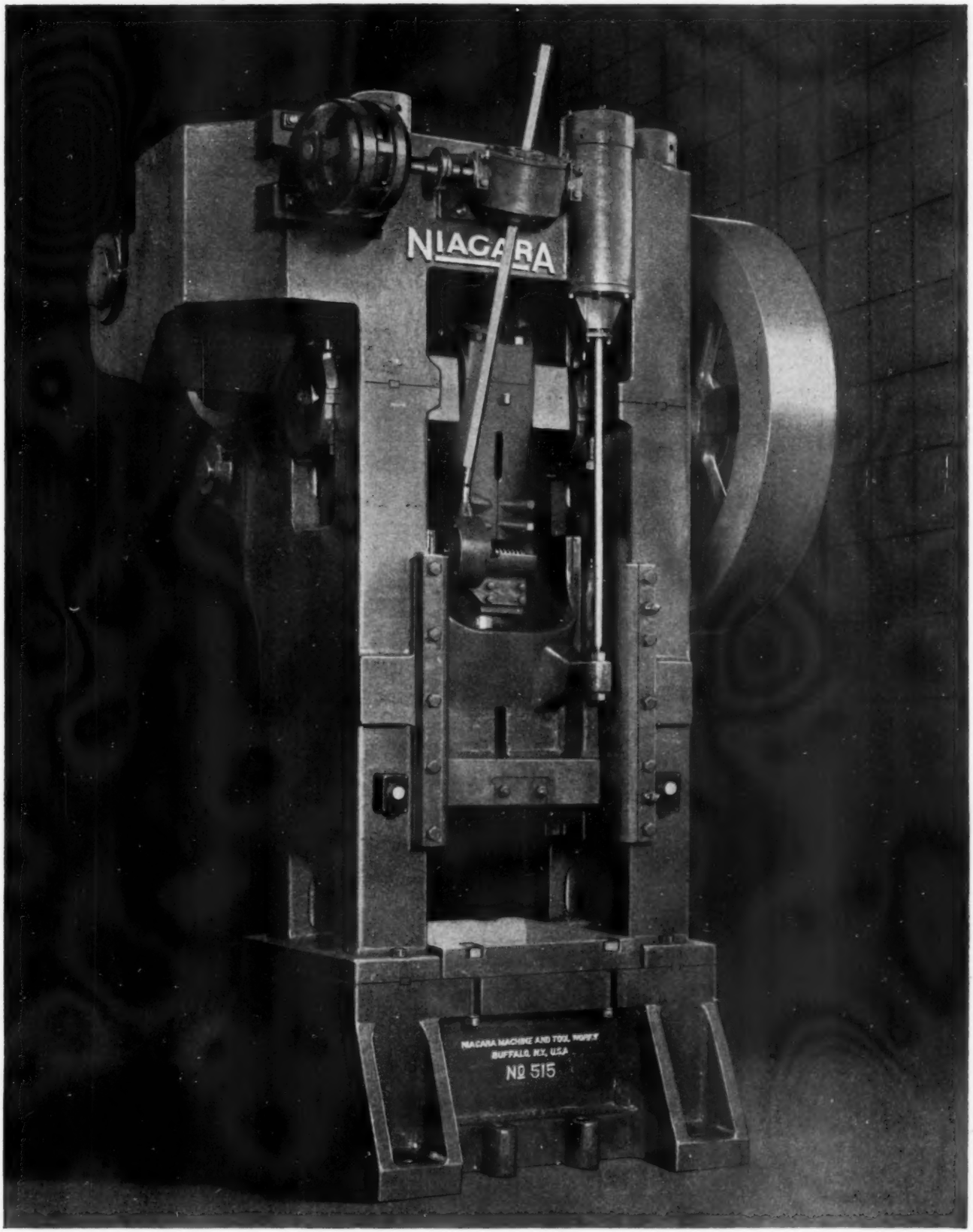
BAKELITE CORPORATION, 30 East 42nd Street, New York
Unit of Union Carbide and Carbon Corporation

UCC

BAKELITE
TRADE MARK

The word "Bakelite" and the identifying products Symbol are registered trade-marks of Bakelite Corporation

PLASTICS HEADQUARTERS



Niagara Series 50 Single Crank Presses are widely used in the production of heavy stampings requiring a concentrated pressure.

Manufacturers are taking advantage of their versatility in performing many operations essential to modern production,—including punching, shearing, blanking, trimming, forging, bending, drawing and embossing. They are also suitable for broaching, reducing and redrawing when provided with long strokes.

Built in a complete range of sizes. Write for Bulletin 63-C. Niagara Machine & Tool Works, 637 Northland Ave., Buffalo, N. Y. Branches: Cleveland, Detroit, New York.

—Advt.

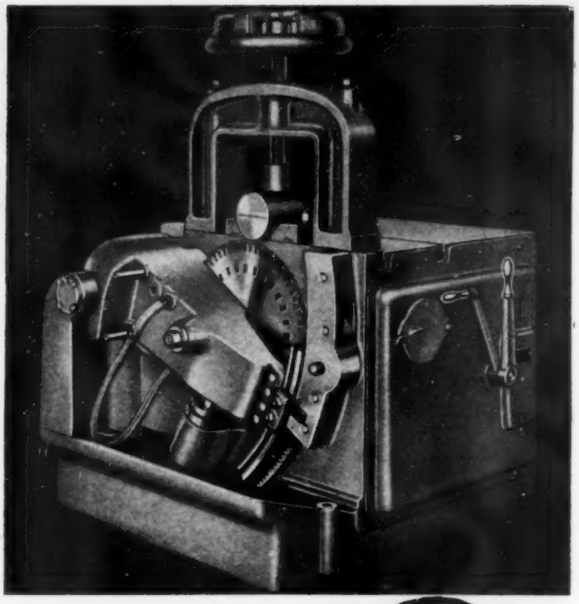
. . . for BIG SAVINGS, put your cold metal sawing work ON THE NEW 8" PORTER-McLEOD

It will pay you to take advantage of the modern features of design and operation which are available in this new, convenient, versatile, enclosed motor driven unit.

Machine has a capacity of 8" round and 7½" square. A Special Holding Fixture enables multiple cutting to be done up to capacity. For instance, 3 pieces of round stock 4½" diameter can be cut at one time and smaller sizes in greater quantity.

Adjustable blade support in which old fashioned stationary wear strips are eliminated, permits the use of various blade thicknesses. This support is also sturdy, insuring accuracy and preventing "jumps" or "wobbles" which might otherwise cause blade damage. Capacity is such as to permit "nesting" of bars or shapes.

Other features include upward feed of blade to stock, preventing riding or bumping; friction disc feed which insures against blade breakage; pulling of blades through cut from in front and below on a diameter well out from the center of the blade, method of operation which eliminates weaving and buckling.



Full description and detailed specifications are covered in our new Bulletin describing this machine. Write for a copy.

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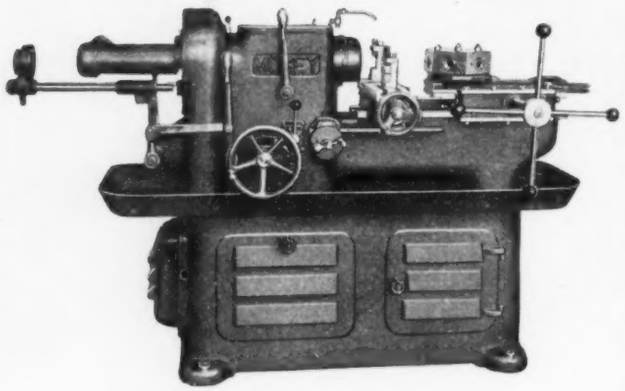

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Unless otherwise specified, are fitted to cylindrical sub-presses as illustrated. They are made either plain, compound, or tandem as the nature of the part requires or the customer requests. Our forty years of successful operation has given us the experience and data necessary to produce satisfactory results. Send your samples and drawings for suggestions and prices

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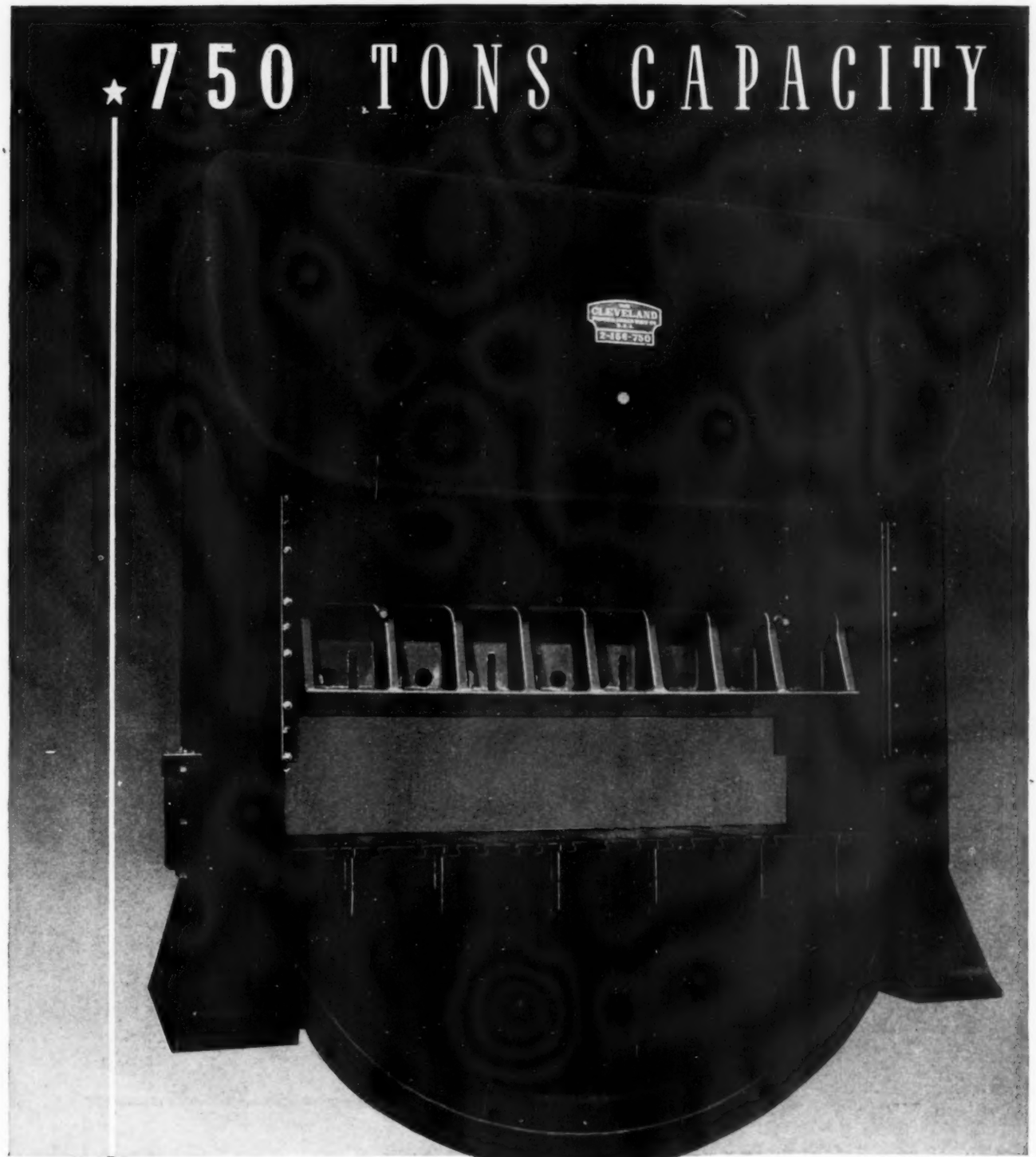

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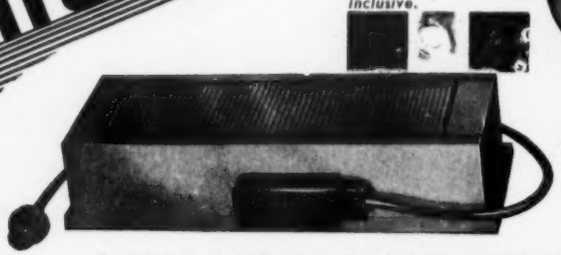

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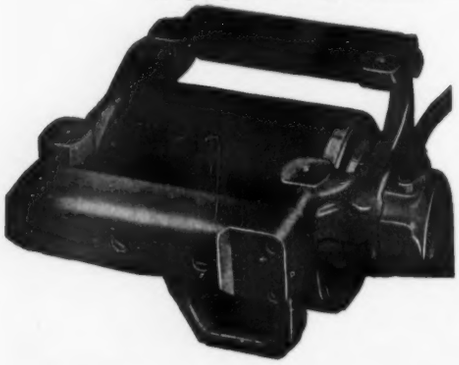

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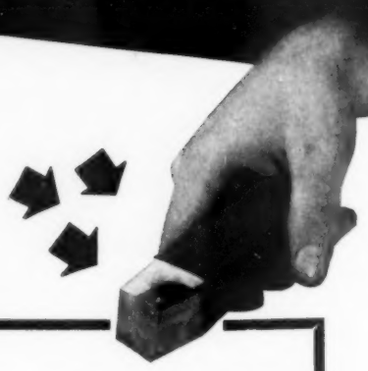

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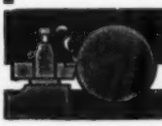

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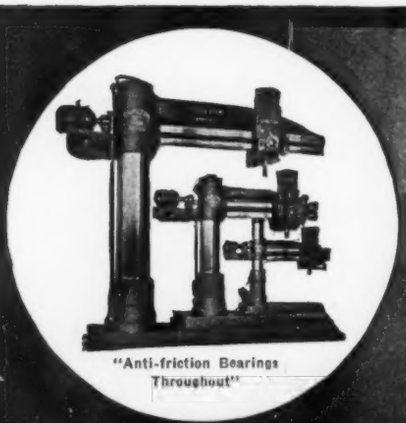

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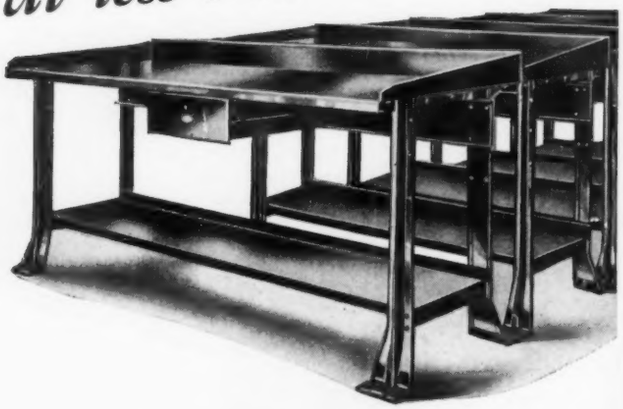

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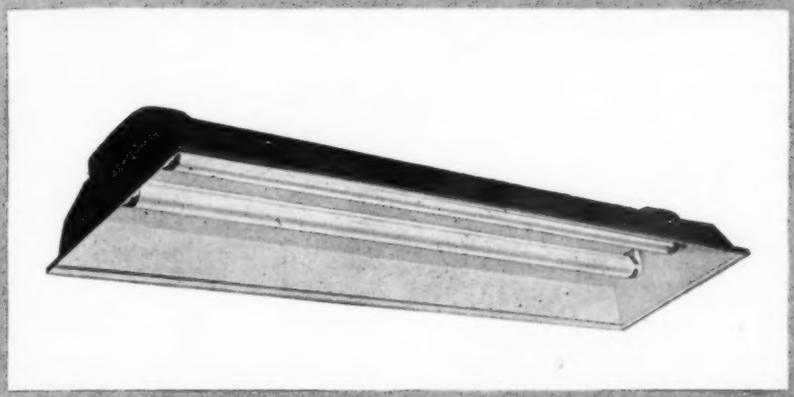

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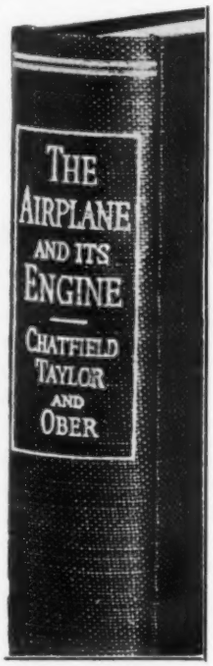

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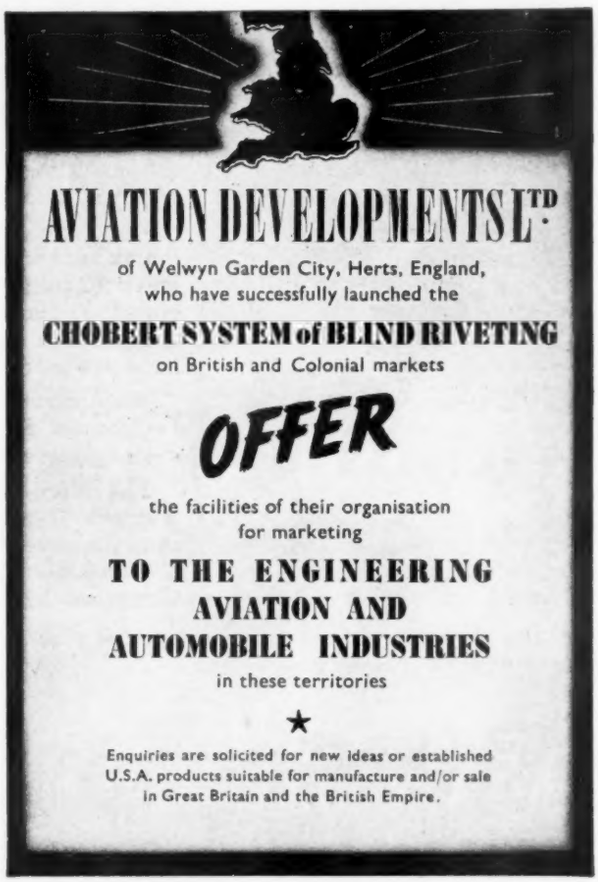
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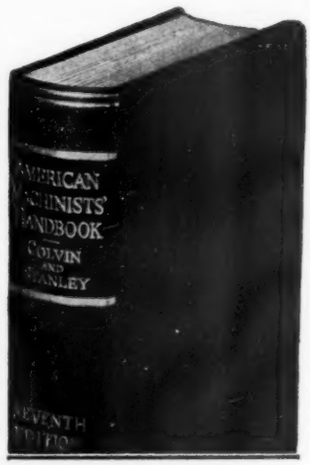

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3x36" Jones & Lamson 2 spindle Geared Head, chucking
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36"x36"x10' Cincinnati, belt, 3 heads
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32"x32"x8' Gray, belt, 1 head
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24" Cincinnati, cone
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16x6 Lodge & Shipley Geared Head; M.D.
16x6 Hendey; Tie-Bar; Q.C.G.
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24x12 Crawford Q.C.G. cone
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STARK PRECISION, Bench, (2)

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#4 Cincinnati H.P. Plain
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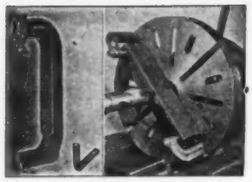

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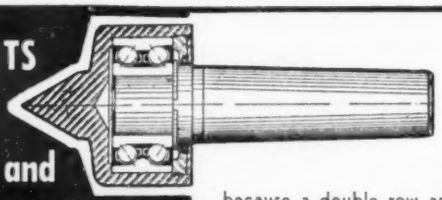

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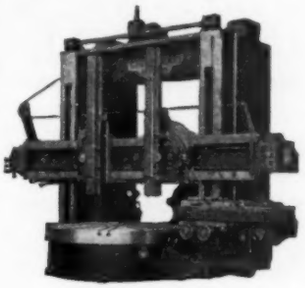

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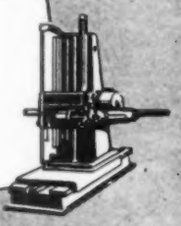

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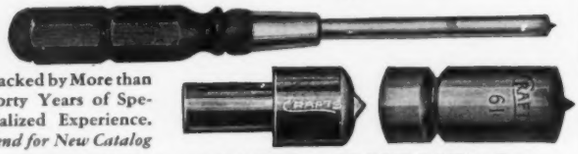

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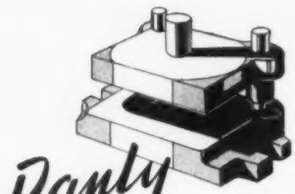

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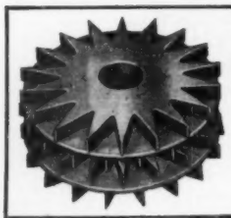

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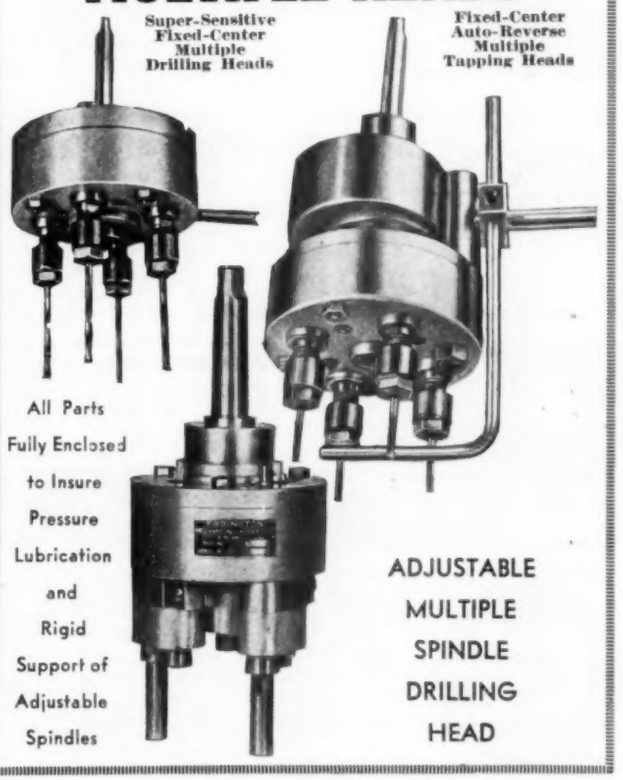
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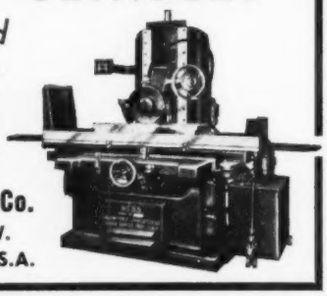

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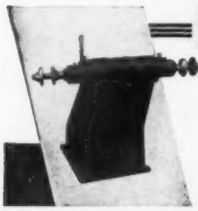

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Gallmeyer & Livingston Co., Grand Rapids, Mich.
Geometric Tool Co., New Haven, Conn.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
LeBlond Machine Tool Co., R. K., Cincinnati, Ohio
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Oliver Instrument Co., Adrian, Mich.
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Norton Co., Worcester, Mass.

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Oliver Instrument Co., Adrian, Mich.

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Arter Grinding Machine Co., Worcester, Mass.

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Abrasive Machine Tool Co., East Providence, R. I.

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Van Norman Machine Tool Co., Springfield, Mass.

GRINDING MACHINES, Ring
Arter Grinding Machine Co., Worcester, Mass.

GRINDING MACHINES, Roll
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Norton Co., Worcester, Mass.
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Reid Brothers Co., Inc., Beverly, Mass.
Walker Co., O. S., Worcester, Mass.

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Jones & Lamson Machine Co. Springfield, Vt.
Oliver Instrument Co., Adrian, Mich.

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Norton Co., Worcester, Mass.

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Hammond Machinery Builders, Inc., Kalamazoo, Mich.
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HOISTS, Hand
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HONING MACHINES
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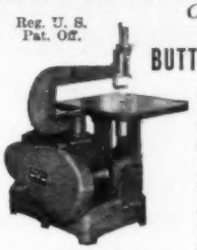

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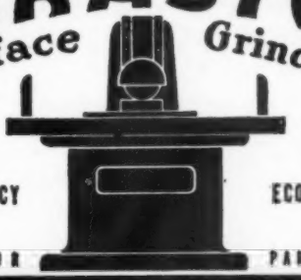

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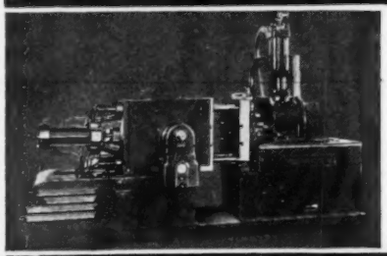

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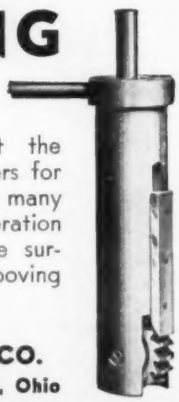

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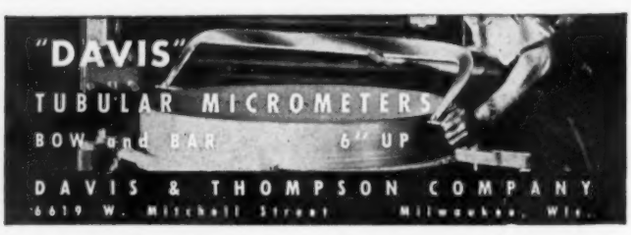

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Warner & Swasey Co., Cleveland, Ohio

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Lodge & Shipley Mach. Tool Co., Cincinnati, Ohio
Monarch Machine Tool Co., Sidney, Ohio
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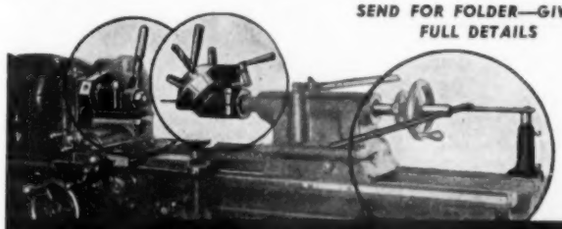

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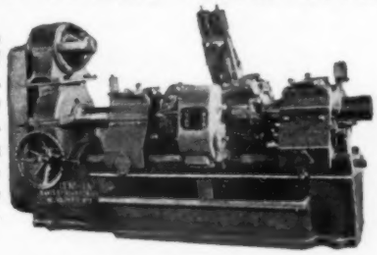

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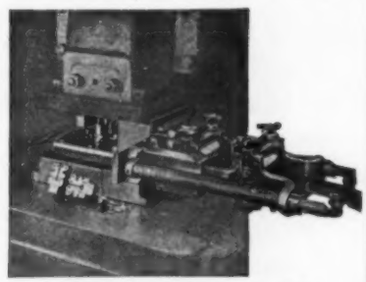

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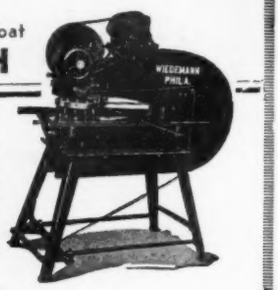
a powerful motor driven deep throat
TURRET PUNCH



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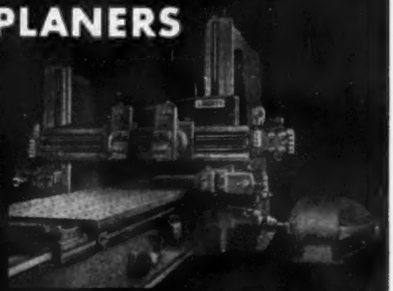

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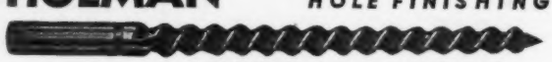

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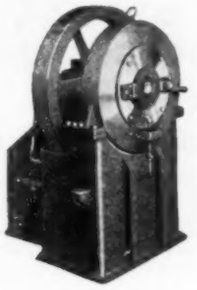

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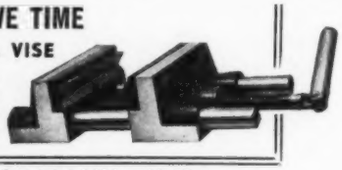

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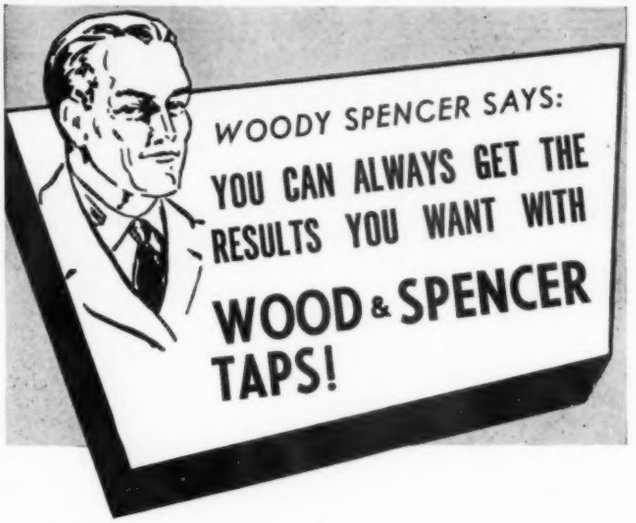

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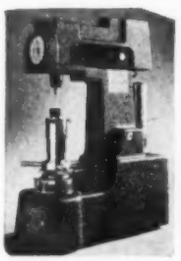

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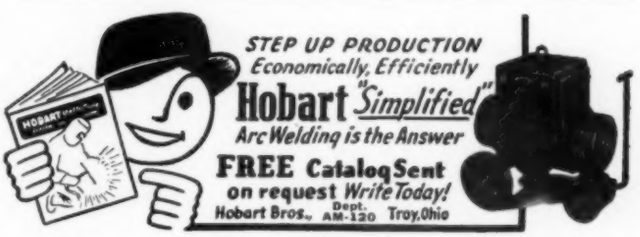

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